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COMPREHENSIVE RISK ASSESSMENT

VOLUME 3

Risk Assessment for the West Area Exposure Unit

DECEMBER 23, 2004

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ACRONYMS

AI	adequate intake
BZ	Buffer Zone
CAS	Chemical Abstract Services
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNHP	Colorado Natural Heritage Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CSF	cancer slope factor
DAF	dermal absorption factor
DER	duplicate error ratio
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DRI	dietary reference intakes
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ER	Environmental Restoration
ERA	ecological risk assessment
ESL	ecological screening level
EU	exposure unit
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IA	Industrial Area

IHSS	Individual Hazardous Substance Site
K-H	Kaiser-Hill Company, L.L.C.
LOAEL	lowest observed adverse effects level
MaxDL	maximum detection limit
MDC	maximum detected concentration
MDL	method detection limit
ML	mass loading
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
NCEA	National Center for Environmental Assessment
ND	not detected
NOAEL	no-observed-adverse-effect level
OU	Operable Unit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
PQL	practical quantitation limit
PRG	preliminary remediation goal
QC	quality control
RDA	recommended daily allowance
RDI	recommended daily intake
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RFNWR	Rocky Flats National Wildlife Refuge
ROD	Record of Decision
RPD	relative percent difference
SMDP	scientific management decision point
tESL	threshold ecological screening level

UCL	upper confidence limit
UL	upper limit daily intake
U.S.	United States
VOC	volatile organic compound
WAEU	Western Area exposure unit
WRS	Wilcoxon Rank Sum Test
WRV	Wildlife Refuge Visitor
WRW	Wildlife Refuge Worker
WSF	West Spray Field

UNIT DESCRIPTIONS

cm2	square centimeter
hr/day	hours per day
kg	kilograms
kg/m3	kilograms per cubic meter
m3/hr	cubic meters per hour
m3/kg	cubic meters per kilogram
mg	milligram
mg/cm2	milligrams per square centimeter
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
pCi	picocurie
pCi/g	picocuries per gram
ppb	parts per billion
ppm	parts per million
µg/kg	micrograms per kilogram
µg/m3	micrograms per cubic meter

1.0 WEST AREA EXPOSURE UNIT

The purpose of the comprehensive risk assessment (CRA) is to assess human health and ecological risks posed by organics, metals, and radionuclides remaining at the Rocky Flats Environmental Technology Site (RFETS) following accelerated actions. This report, Volume 3, presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the 468 acre West Area Exposure Unit (WAEU) at RFETS as shown in Figure 1.1.

The HHRA and ERA methods and selection of receptors is described in detail in the Final Comprehensive Risk Assessment Work Plan and Methodology (DOE 2004a), hereafter referred to as the CRA Methodology. The anticipated future land use of RFETS is a wildlife refuge. Consequently, two human receptors are evaluated consistent with this land use, a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV). A variety of representative terrestrial and aquatic receptors are evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species known to be present on RFETS.

1.1 West Area Exposure Unit Description

This section provides a brief description of the WAEU, including its location, historical activities in the area, topography, surface water features, vegetation and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology and soil types at RFETS is included in the Site Physical Characteristics Summary Report, Section 2, of the Draft Remedial Investigation/Feasibility Study (RI/FS) Report, and Volume 2 of this CRA Report.

1.1.1 Exposure Unit Characteristics and Location

The WAEU is located on the western perimeter of RFETS and consists of 468 acres (Figure 1.1). It has several distinguishing features as noted:

- The WAEU is located within the Buffer Zone Operable Unit (BZ OU) and is outside areas that were used historically for the operations of the Rocky Flats Plant.
- Sources of contamination are not present within the WAEU boundaries. It is not significantly affected by releases from RFETS because it is upwind and hydraulically upgradient relative to RFETS' contaminant release locations.
- It is a functionally distinct exposure area due to large areas with disturbed soil (gravel mining), sparse vegetation and relative scarcity of water and wetland habitat; and
- The WAEU is part of two watersheds, the Rock Creek and Walnut Creek Drainages.
- The WAEU has large areas with disturbed soil, unlike other exposure units (EUs) at RFETS, because of historical and current gravel mining operations. It has sparse vegetation and wetland habitat because of the relative scarcity of water.

- The WAEU has been designated as part of the Rocky Flats National Wildlife Refuge (RFNWR) and may have public access.

The WAEU is bounded by the Rock Creek Drainage and Inter Drainage EUs to the east and by the DOE Wind Research Site to the north (Figure1.1). Land to the west and south of the WAEU, outside of the RFETS boundary, is privately owned. Highway 93, which runs north to south and connects the cities of Boulder and Golden, is located approximately 1,500 feet (ft) west of the WAEU boundary.

1.1.2 Historic Activities and Potential Sources

The WAEU is located within the BZ OU, upgradient of the area that was used for RFETS operations (Figure 1.1). There are no known sources of groundwater or soil contamination within this EU based on the Historical Release Report (DOE 1992a), which provides a description of known spills, releases or incidents (or both) involving hazardous substances occurring since the inception of the Rocky Flats Plant. These releases are designated Individual Hazardous Substance Sites (IHSSs) or Potential Areas of Concern (PACs). The only potential nearby source area is IHSS 168, the West Spray Field, which is located to the east of the WAEU. Excess water from the Solar Evaporation Ponds was periodically sprayed within IHSS 168 between April 1982 and October 1985 (DOE 1992b).

A Colorado Department of Public Health and Environment (CDPHE) Risk-Based Conservative Screen was conducted for IHSS 168 by DOE (1995b). A no-further-action Corrective Action Decision/Record of Decision (CAD/ROD) was approved for IHSS 168 (also designated Operable Unit 11 [OU11]) in October 1995. (Administrative Record reference OU11-A-000184). It is unlikely that IHSS 168, located outside the WAEU and hydraulically downgradient, is a source of contaminants for the WAEU.

1.1.3 Topography and Surface Water Hydrology

A recent aerial photograph of the WAEU shows that soil in the northern and southern portions of the EU has been disturbed by gravel mining activities (Figure 1.2). The disturbed areas occupy a majority of the surface area of the WAEU, and consist of excavations, ponds, soil piles, and roads.

The WAEU is relatively level, compared to the rest of RFETS, which is located on a broad, eastward sloping pediment that is deeply transected by several stream valleys in the eastern portion of RFETS. Although several ephemeral or intermittent creeks originate just west of and within the WAEU (Figure 1.2) and traverse the EU in a west to east-north east direction, the channels are shallow. Named creeks in the WAEU include the Mahonia and Lindsay Branches of the Rock Creek Drainage and portions of Church and McKay ditches. Ground water in the EU originates upgradient of RFETS and is not affected by Site activities. A small natural pond is also located in the WAEU. The white surface deposits that are recognizable on the aerial photograph in Figure 1.2 are most likely caliche, or calcium carbonate, that forms by evaporation of vadose zone water.

Flora and Fauna

A vegetation map for the WAEU is shown in Figure 1.3. Areas that have not been disturbed by mining are characterized predominantly by xeric tallgrass prairie on the plains, and wetland and mesic mixed grassland in and adjacent to the drainages. Small areas of tall upland shrubland and other shrubland also exist. The xeric tallgrass prairie is distinguished at RFETS by such plant species as big bluestem (Andropogon gerardii), little bluestem (Andropogon scoparius), indian grass (Sorghastrum nutans), prairie dropseed (Sporobolus heterolepis), and switchgrass (Panicum virgatum); the same species that dominate the plant community on the eastern edge of the Great Plains.

Numerous animal species have been observed at RFETS and the more common ones are also expected to be present in the WAEU. Common large and medium-sized mammals likely to live at or frequent the WAEU include mule deer (Odocoileus hemionus), coyotes (Canis latrans), raccoons (Procyon lotor), desert cottontail (Sylvilagus audubonii), and white-tailed jackrabbit (Lepus townsendii). The most common reptile observed at RFETS is the western prairie rattlesnake (Crotalis viridus) and the most common birds include meadow larks (Sturnella neglecta) and vesper sparrows (Pooecetes gramineus). The most common small mammal species include deer mice (Peromyscus maniculatus), prairie voles (Microtus ochrogaster), meadow voles (Microtus pennsylvanicus), and different species of harvest mice (Reithrodontomys sp.).

The PMJM is a federally listed threatened species that occurs at RFETS. The preferred habitat for the PMJM is found in the riparian corridors bordering streams, ponds, and wetlands at RFETS. Small areas designated as PMJM habitat occur along three drainages in the WAEU as shown in Figure 1.4.

More information on the species that use the habitats at RFETS is provided in Section 2 of the RI/FS Report.

1.1.4 Data Description

Data are available for surface soil, subsurface soil, sediment, surface water and groundwater in the WAEU. The sampling locations for these media are shown in Figure 1.5 and data summaries for detected analytes in each medium are provided in Tables 1.1 through 1.6. Analytes that were analyzed for but not detected are presented in Appendix A. Detection limits are compared to PRGs and ESLs in Appendix A (Tables A.1 through A.6).

In accordance with the CRA Methodology, only data collected on or after June 28, 1991 and data for subsurface soil less than eight ft in depth are used in the CRA and are included in the data summaries presented in this section. Subsurface soil data is truncated at eight ft because it is not anticipated that the WRW or burrowing animals will dig to greater depths. Sampling events that occurred prior to this date or at greater than eight ft are described in Appendix A, but those data are not used in the CRA.

A summary of the number of samples available for each medium in the WAEU is provided in Table 1.1 and the data are briefly described in the following sections.

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Surface Soil

Ten surface soil samples from a depth of 0 to 0.5 ft were collected in the WAEU in March of 2004 (Table 1.1). The surface soil sampling locations shown in Figure 1.5 were collected from a 30-acre grid, as described in the Comprehensive Risk Assessment Sampling and Analysis Plan 04-01 (DOE 2004b). Five individual samples were collected from each square, one from each quadrant and one in the center, and the five samples were composited. One sample, location AN33-000 (Figure 1.5), was a composite of three individual samples. Samples were not collected in some grid points because they were located in an area of disturbed soil. Some grid cells were not sampled because of the extent of disturbed soil.

A data summary for detected analytes in surface soil in the WAEU is shown in Table 1.2. Detected analytes included several radionuclides and inorganics. Most inorganics were detected in all ten surface soil samples.

Sediment

Ten sediment samples were collected at depths from 0 to 0.5 ft at two locations shown on Figure 1.5. Location SED004 was sampled six times and location SED023 was sampled four times, between August 1991 and March 1993. The sediment samples analyzed for inorganics and organics; radionuclides were analyzed in eight of the ten samples.

The data summary for sediment in the WAEU is shown in Table 1.3. Frequently detected analytes in sediment included various inorganics and radionuclides. Detected organics included 2-butanone, 4-methylphenol, benzoic acid, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, fluoranthene, pyrene, and toluene. All detections were "J" qualified signifying that the reported result is below the method detection limit (MDL) and above the instrument detection limit. Most of the organics were detected in only one sample, with the exception of 2-butanone and the phthalates, which were detected in 30 to 40 percent of samples. Ester phthalates are associated with the plastic tubing in sampling equipment and are considered common laboratory contaminants by the EPA (1989).

Subsurface Soil

Subsurface soil samples were collected from one location in the southeast portion of the WAEU (Figure 1.5). Subsurface soil samples are defined in the CRA Methodology as soil samples with an ending depth below 0.5 ft. The CRA Methodology also states that only subsurface soil collected from less than or equal to 8 ft will be used in the risk assessment. A total of 16 subsurface soil samples were collected at location 46192. The 16 samples from location 46192 were collected from 5-ft depth intervals ranging up to 80 ft in depth.

The subsurface soil data were divided into two datasets, one containing all soil samples collected at a starting depth less than or equal to 8 ft, and one containing those with a starting depth greater than 8 ft. The datasets are referred to as soil < 8 ft and soil > 8 ft, respectively, in the text and tables. The data summary for soil < 8 ft is presented in Table 1.4, and the data are discussed in this section. The data summary for soil > 8 ft is presented and the data are discussed in Appendix A (Section A-2).

Two samples were collected from soil < 8 ft deep. Both samples were analyzed for inorganics.

Surface water

Surface water samples were collected from three sampling locations in the WAEU. The sampling locations are shown in Figure 1.5 and the data summary for surface water is presented in Table 1.5. A total of 69 surface water samples were collected in the WAEU between July 1991 and March 2004 and all are used in the CRA (Table 1.1). All samples were analyzed for inorganics (metals), 16 for organics and 15 for radionuclides. Detected analytes included representatives from all three groups.

Groundwater

Eighty-one groundwater samples were collected from eight locations between July 1991 and July 1995 (Table 1.1). A variety of inorganics, organics and radionuclides were detected at low concentrations (Table 1.6). These samples were collected as upgradient samples for comparison to potential source areas downgradient.

1.2 Data Adequacy

- A data adequacy assessment was performed to determine if the dataset was adequate for risk assessment purposes. The Data Adequacy Assessment Rules were presented in the CRA Methodology (DOE 2004a). The data for the WAEU are considered adequate for the CRA, because the following criteria are met:
- One metal and radionuclide surface soil sample is available per 30-acre block (DOE 2004b). This data density is considered sufficient for areas outside of source areas;
- Sediment and surface water samples exist for stream beds along the major drainages; and
- Groundwater samples were taken in the southeast portion of the WAEU.
- The data are considered representative for the WAEU and are adequate for quantitative risk assessment.

1.3 Data Quality Assessment

A data quality assessment (DQA) was performed to assess the precision, accuracy, representativeness, completeness, and comparability (PARCC) of the WAEU dataset. An analysis of methods and detection limits was also included as part of the DQA. This section briefly discusses of the findings of the DQA, summarizing the frequency of the required quality control (QC) checks and the attainment of QC criteria for the PARCC and sensitivity parameters. The full DQA is presented in Appendix B.

1.3.1 Precision

The data from the field duplicates, laboratory duplicates, matrix spike duplicates, and laboratory control sample duplicates were reviewed to assess project precision. For radiochemistry parameters, the precision criterion was a maximum duplicate error ratio (DER) of 1.96 (Lockheed Martin 1997). For other parameters, the precision criteria were

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a relative percent recovery (RPD) of 20 percent for water samples and 35 percent for soil samples (EPA 2003). Only a few outliers were found relative to these criteria, and none of the associated sample results were near the preliminary remediation goals (PRGs). On this basis, no precision problems were found that would affect the project decisions. However, analysis frequency appeared to be low (below 5 percent or 1 per batch) for matrix spike duplicates, laboratory control sample duplicates (LCSDs), and laboratory duplicates. These samples were either not processed by field or laboratory staff, or else were not incorporated into the project analytical database that was used for the DQA. Requirements for these QC checks are method-specific, and they may not have been required for many of the early investigation activities and analytical methods applied at the WAEU. Although only limited data were available for these QC checks, the DQA found that field duplicates were collected at an apparent frequency of greater than the required 5 percent for many parameters. The significant number of field duplicates collected over the WAEU indicated an acceptable overall level of precision for the dataset.

1.3.2 Accuracy

The percent recoveries from the matrix spike, matrix spike duplicates, laboratory control samples, and surrogates were reviewed to assess accuracy. The accuracy criteria were method specific, but generally followed the criteria from the EPA Contract Laboratory Program Statements of Work (EPA 2003). Again, only a few outliers were found relative to the accuracy criteria. A low percent recovery (35%) was noted for iron in a matrix spike performed on a surface soil sample with a concentration (12,000 mg/kg) that was near the PRG (33,326 mg/kg). However, because the sample concentration was high relative to the spike concentrations, creating greater uncertainty in the percent recovery, no impacts to project decisions were assessed. Limited information provided for laboratory control samples in the database impacted the ability of data reviewers to batch these QC data with associated samples, and surrogate recoveries were not included in the database for all the samples analyzed for organic parameters. Overall, the accuracy of the data was acceptable based on the data reviewed, and the results had minimal effect on the project decisions.

1.3.3 Representativeness

The representativeness was assessed by evaluating the method selection, blank contamination, and the overall precision and accuracy of the dataset as indicated by the range of QC checks summarized above. The representativeness of the data for this EU was adequate and did not affect the project decisions.

1.3.4 Comparability

Comparability was assessed by evaluating the methods used to analyze the data. There were several different methods and laboratories used in this dataset. The sampling occurred over a long time period and there were revisions to the test methods during this time. Most revisions (for example, to the CLP SOWs) were minor and are not anticipated to affect data comparability. Overall, the DQA found that the project laboratories used promulgated methods and good standard laboratory practices, producing a comparable dataset. Spot checks and surveys of the datasets for individual target analytes affirmed

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this comparability, indicating that results produced over different timeframes with slight variations in analytical methods showed similar ranges of concentrations.

1.3.5 Completeness

The completeness was determined by evaluating the total number of results in the dataset compared to the number of valid, usable results. Rejected data is not usable for quantitative risk assessment purposes. In this dataset, 3.5 percent of the data were rejected which yields a completeness value of 96.5 percent. This exceeds the completeness goal of 90 percent.

1.3.6 Sensitivity and Reporting Limits

The blanks were evaluated using the field, trip and method blanks. This review also evaluated the highest non-detected results compared to the method requirements. All of the blanks contained some contamination; however, most of the values were less than one-tenth of the PRG. One value for Uranium 238 in an equipment rinsate was near one-tenth of the PRG; however the associated sample's Uranium-238 result was rejected and not usable. The reporting limits for the undiluted samples met the method requirements. This analysis returned no findings that may affect the project decisions.

1.3.7 Overall Assessment of Data Quality

QC parameters were generally within control criteria based on the findings of this DQA. With the exception of iron in surface soil, all valid data is considered to be usable. However, some QC checks could not be fully assessed due to low QC sample frequencies or other gaps in the project database. These low QC frequencies and QC data gaps primarily affect the older data within the WAEU dataset. Because the older data appear comparable to newer data that have sufficient QC frequencies, there appear to be no significant effects on the usability of the dataset as a whole to support project decisions.

2.0 SELECTION OF HUMAN HEALTH CONTAMINANTS OF CONCERN

The human health COC screening process is illustrated on Figure 2.1 and further described in the CRA Methodology, Section 4.4.

Two potential future on-site human receptors are described in the CRA Methodology, a WRW and a WRV. The PRGs used in the COC selection process are based on the WRW exposure scenario and a risk of 1 x 10-6. The PRGs based on the WRW are considered protective for the WRV. The derivation of the PRG values is documented in Appendix A of the CRA Methodology. The background data (DOE 1995b) used for the background screening step are discussed in Volume 2 of the Draft CRA Report.

Only analytes that were detected at least once in a medium are included in the COC screen for that medium. Non-detected analytes are listed and the detection limits for these analytes are evaluated in Appendix A.

The human health COC selection process, as illustrated on Figure 2.1, is conducted for the following media in the WAEU: surface soil, subsurface soil, sediment, and surface water. In addition, analytes in subsurface soil and groundwater are screened for their potential to be released into indoor air at levels that might cause significant human health

effects. Groundwater is also screened if there are sources for contributions to surface water. Results of the COC selection process are summarized in Section 2.6.

2.1 Contaminant of Concern Selection for Surface Soil

2.1.1 Surface Soil Cation /Anion and Essential Nutrient Screen

No analyses were conducted for anions/cations in WAEU surface soils and a screen was not performed. The essential nutrient screen for analytes detected in surface soil is presented in Table 2.1. It includes analytes that are essential for human health, but do not have toxicity values. The PRG screen in Section 2.1.2. includes essential nutrients for which toxicity criteria are available.

Table 2.1 shows the MDCs for essential nutrients, daily intake estimates based on the MDCs, and Dietary Reference Intakes (DRIs). These are identified in the table as RDAs/RDIs/AIsMDCs, and the WRW soil ingestion rate of 100 mg/day. The estimated daily maximum intakes are less than the DRIs. These analytes are not further evaluated as COCs for surface soil.

2.1.2 Surface Soil Preliminary Remediation Goals Screen

The PRGs for surface soil are based on exposure assumptions for a WRW scenario (DOE 2004a). The MDCs of the PCOCs in surface soil are compared to WRW PRGs. All PCOCs in surface soil that remained after the essential nutrient evaluation are included in the PRG screen.

Table 2.2 presents the ratios of the MDCs to the WRW PRGs for each PCOC. If the MDC/PRG ratio for a PCOC is greater than one, the PCOC is retained for further screening. Otherwise it is eliminated. Only arsenic had a MDC that exceeded its PRG for surface soil in the WAEU and is retained as a PCOC. Arsenic is further evaluated in the following sections.

2.1.3 Surface Soil Frequency of Detection Screen

Arsenic was the only chemical for which the maximum detected concentration in surface soil exceeded the PRG. Arsenic was detected in all 10 surface soil samples; detection frequency is not further evaluated

2.1.4 Surface Soil Background Analysis

A statistical analysis was conducted to determine whether arsenic concentrations in WAEU surface soil are higher than those in background surface soil at the 0.1 level of significance as specified in the CRA Methodology (DOE 2004a). The WAEU data were compared to a surface soil background dataset consisting of 20 individual sampling points (DOE 1995b). The background data are described in detail in Volume 2 of the Draft CRA Report.

Figure 2.1 Human Health COC Selection Process

The background analysis utilized two statistical programs, ProUCL (Version 3.0) and S-Plus as called for in the CRA Methodology and described in detail in Appendix A of Volume 2. ProUCL was used to determine the distributions of the WAEU and background datasets. The distribution types determine the appropriate statistical test for the background comparison. S-Plus was then used to compare the two datasets. The results of the background analysis for arsenic in surface soil are described below and are summarized in Table 2.3 and 2.4. Output files from the statistical programs are provided in Appendix C.

The analyses with the ProUCL program indicated that the WAEU surface soil and background surface soil data for arsenic have gamma and normal distributions, respectively. The Wilcoxon Rank Sum Test (WRS) indicated that the WAEU median concentration for arsenic in the WAEU is greater than the background median at the 0.1 significance level. The results of two other statistical tests that are extensively used for comparing populations of environmental data, the quantile test (EPA 2002) and the slippage test (DOD 1998), are also shown in Table 2.4. Both of these tests show that the WAEU data are within the range of variability expected for the background dataset.

Arsenic concentrations in surface soil at the WAEU ranged from 3.6 to 22 mg/kg as shown on Figure 2.2. The sample concentration, 22 mg/kg, was collected at location AN33-000, in the southeastern portion of the WAEU. When the outlier is removed, the WAEU and background datasets are similar and the maximum concentration for the WAEU is below that for background. Table 2.5 shows the range of data for the WAEU and background arsenic datasets and provides means, median, and the upper 95 percent confidence limits of the mean (UCLs). The mean for the WAEU is 8.5 and 6.1 mg/kg for background; the UCLs are 11.6 for the WAEU and 7 mg/kg for background, respectively.

The box plots on Figure 2.3 show the medians (midpoints), the spread or variability of the two datasets, the skewness around the median (boxes and whiskers), and any "unusual" values. A comparison of the box plots shows that the WAEU data falls within the range of the background data and that the distributions of the data are very similar, with the exception of the 22 mg/kg value. The range for arsenic in surface soil of the western United States (U.S.) is 0.1 to 97 mg/kg with an arithmetic mean of 7 mg/kg (Shacklette and Boerngen 1984). Arsenic at the WAEU falls well within this range and there is no evidence of contamination. Arsenic is not further considered as a PCOC.

2.1.5 Professional Judgment for Surface Soil

Arsenic is the only PCOC in surface soil that exceeds the WRW PRG. The results of the background comparison for arsenic concentrations in surface soil in the WAEU indicate that arsenic concentrations in the EU are very similar to background and with in a normal range for western soils. The arsenic concentrations in the WAEU are likely due to natural variation of primordial arsenic concentrations in the alluvial materials that made up the parent material for the soils. Arsenic in surface soil is not further evaluated in this human health assessment.

2.2 Contaminant of Concern Selection for Sediment

2.2.1 Sediment Cation/Anion and Essential Nutrient Screen

Data for cations, anions and essential nutrients without toxicity criteria were not collected for sediment. Therefore, a screen was not performed.

2.2.2 Sediment Preliminary Remediation Goal Screen

The PRG screen for sediment is presented in Table 2.6. The surface soil PRG is used because soils and sediments are combined for risk calculations as discussed in the CRA Methodology (DOE 2004a). PCOCs for which the MDC/PRG ratio exceeded one are bolded and include two inorganic analytes, arsenic and manganese, and two radionuclides, cesium-137 and radium-228. These PCOCs are further evaluated below.

2.2.3 Sediment Detection Frequency Screen

Arsenic and manganese were detected at a frequency of 100 percent. The detection frequencies for radionuclides are considered to be 100 percent per DOE Order 5400.5 (DOE 1990). Only PCOCs with detection frequencies of less than 5 percent are eliminated in this screen, therefore, arsenic, manganese, cesium-137 and radium-228 are retained and are further evaluated in the following sections.

2.2.4 Sediment Background Analysis

The four to ten sediment samples from locations SED004 and SED023 are compared to the background dataset for the four PCOCs that came through the PRG screen. The background sediment samples were collected in the RFETS BZ with EPA and CDPHE approval (DOE 1993) and included some of the samples in the WAEU. For the background analysis for the WAEU all samples collected from the WAEU were removed from the background dataset. The background data are described in detail in Volume 2 and the background dataset with the WAEU samples removed is included in Appendix A.

Both the WAEU and background arsenic sediment data have gamma distributions (Table 2.3). The UCLs are 4.73 for the WAEU and 3.12 mg/kg for background. The WRS Test indicates that the median of the WAEU arsenic data is higher than the background median at the significance level of 0.9 (Table 2.4). Both the quantile and slippage tests indicate that the WAEU and background datasets are from the same population. The box plots for arsenic in Figure 2.4 also show that the background and the WAEU datasets are very similar and that the WAEU data is well within the range of the background data. The MDC of arsenic in background sediment (17.3 mg/kg) is approximately 3 times higher than that in sediment at the WAEU (5.3 mg/kg). Arsenic is not evaluated further.

The WAEU manganese sediment data were determined to have a normal distribution and the background data to have a gamma distribution (Table 2.3). The WAEU and background UCLs were 309 and 318 mg/kg, respectively. The maximum manganese concentration in the WAEU is 470 mg/kg, considerably lower than the background maximum of 1280 mg/kg. The WRS test yielded a p-value of 0.7591, indicating that the median concentration for the WAEU data is not greater than the median for background at the 0.1 level of significance. Manganese is not evaluated further.

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The WAEU and background cesium-137 sediment data have gamma and non-parametric distributions, respectively. The WAEU and background UCLs for cesium-137 were 1.2 and 0.55 pCi/g, respectively. The maximum concentrations for the WAEU and background are equal at 1.5 pCi/g. The WRS, quantile, and slippage tests indicate that the WAEU data is of the same population as background at the 0.1 level of significance. Cesium-137 is not evaluated further.

Both the WAEU and background radium-228 sediment data are normally distributed. The UCLs were 4 and 1.9 pCi/g for WAEU and background, respectively. The maximum Radium-228 concentration in the WAEU is 4.1 mg/kg, slightly higher than the background maximum of 3.5 mg/kg. The WRS indicates that the WAEU median is greater than the background median at the significance level of 0.1. Both the quantile and slippage tests indicate that the WAEU and background datasets are from the same population. The box plot for radium-228 in Figure 2.5 shows that the background and the WAEU datasets are very similar and are in the same range. The slightly higher median and maximum for the WAEU data are likely due to natural variation. The background dataset was collected from several geographically distinct areas that are characterized by different lithologies and soil types. The WAEU data are from two sampling locations.

There is no information that suggests that radium-228 was released due to activities in the WAEU (DOE1992a). As discussed in Section 2.1, the WAEU is located in an upgradient topographic and wind direction from the industrial area where most historic activities associated with RFETS took place. The only nearby area that is associated with any contaminant releases is the West Spray Field, but neither arsenic nor radium-228 were associated with historic spray activities and neither was selected as a COC for this area. Radium-228 is not evaluated further.

2.2.5 Sediment Professional Judgment

All PCOCs for sediment that had concentrations above a PRG were removed during the background comparison step of the COC selection process.

2.3 Contaminant of Concern Selection for Subsurface Soil (< 8 ft)

2.3.1 Subsurface Soil Cation/Anion and Essential Nutrient Screen

Data for cations, anions and essential nutrients without toxicity criteria are not available for subsurface soil. Therefore, a screen was not performed.

2.3.2 Subsurface Soil Preliminary Remediation Goal Screen

The PRG screen for detected analytes in soil < 8 ft is presented in Table 2.7. The MDC/PRG ratio was less than one for all PCOCs. Therefore none of the analytes that were detected in subsurface soil are retained beyond the PRG screen.

2.3.3 Subsurface Soil Detection Frequency Screen

The detection frequency screen is not performed for subsurface soil because there are no PCOCs with concentrations greater than the PRGs.

2.3.4 Subsurface Soil Background Screening

The background analysis was not performed for subsurface soil because there are no PCOCs with concentrations greater than the PRGs

2.3.5 Subsurface Soil Professional Judgment

The professional judgment step is not performed for subsurface soil because there are no PCOCs with concentrations greater than the PRGs.

2.4 Contaminant of Concern Selection for Surface Water

2.4.1 Surface Water Anion/Cation and Essential Nutrient Screen

Anions and cations that have been detected in surface water in the WAEU are listed in Table 2.8. Detected anion/cations included orthophosphate and sulfate. No toxicity values are available for these PCOCs; therefore, orthophosphate and sulfate were not further evaluated.

Essential nutrients without toxicity values that have been detected in surface water in the WAEU are evaluated in Table 2.9. The essential nutrients and estimated intakes, based on the nutrient's maximum detected concentrations and a surface water ingestion rate of 30 ml/day, are compared to the estimated intakes to allowable dietary values. The estimated daily intakes for calcium, magnesium, potassium, and sodium in surface water were below the allowable dietary values for these PCOCs and they are not further evaluated.

2.4.2 Surface Water Preliminary Remediation Goal Screen

The PRG screen for detected PCOCs in surface water is presented in Table 2.10. None of the detected analytes had MDC/PRG ratios greater than 1. Four organics were detected at very low concentrations in surface water. There was a single "J" qualified result for 2-butanone, signifying an estimated value below the method detection limit. Acetone and methylene chloride, both common laboratory contaminants, were detected in one sample each. It is likely that all three analytes are laboratory artifacts.

There is no toxicity data for oil and grease and it is not retained as a PCOC. Further evaluation is provided in the uncertainty analysis in Section 6.

2.4.3 Surface Water Detection Frequency Screen

The detection frequency screen is not performed for surface water because there are no PCOCs with concentrations greater than the PRGs.

2.4.4 Surface Water Background Analysis

The background analysis was not performed for surface water because there are no PCOCs with concentrations greater than the PRGs

2.4.5 Surface Water Professional Judgment

The professional judgment step is not performed for surface water because there are no PCOCs with concentrations greater than the PRGs

2.5 Pathway Significance Evaluations

As described in the CRA Methodology (DOE 2004a), the following pathways are evaluated for their potential significance in each EU:

- The groundwater-to-surface water pathway; and
- The subsurface soil/groundwater-to-air pathway.

The groundwater-to-surface water pathway does not need to be evaluated for the WAEU, because groundwater originating on RFETS does not flow to the surface in this area. There are a few intermittent groundwater seeps near the head waters of the Lindsay Branch of Rock Creek, but the shallow streams in the WAEU are not fed by groundwater (DOE 1995a).

The second pathway, volatilization to indoor air is theoretically complete for the WAEU, because volatiles have been detected in groundwater. Data were not collected for volatiles in subsurface soil and there are no known sources (DOE 1992). This pathway is further evaluated using PRGs developed specifically for the CRA that are based on inhalation of indoor air by WRW. The development methods and assumptions for these PRGs are presented in Appendix A of the CRA Methodology.

The maximum detected concentrations for VOCs in groundwater are compared to PRGs in Table 2.11. The MDC/PRG ratios for all detected PCOCs in groundwater were less than 1, indicating that the groundwater to indoor air pathway is not significant for the WAEU and does not need to be further evaluated.

2.6 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.12. No COCs were selected for any of the media at the WAEU.

3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The purpose of the human health exposure assessment is to:

- Develop an EU-specific Site Conceptual Model (SCM);
- Calculate exposure point concentrations for each medium for which COCs have been selected; and
- Estimate chemical intakes for the WRW and WRV.

Methods and assumptions are presented in the CRA Methodology (DOE 2004a). An exposure assessment for the WAEU is not conducted, because no COCs were selected for any medium in the WAEU and quantitative risk assessment is not necessary.

4.0 HUMAN HEALTH TOXICITY ASSESSMENT

The purpose of the human health toxicity assessment is to:

- Identify toxicity criteria for each noncarcinogen, chemical carcinogen, and radionuclide;

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- Characterize and describe the toxicity of each COC; and
- Identify dose conversion factors for each radionuclide COC.

Toxicity values for carcinogens are expressed as cancer slope factors (CSFs) and toxicity values for noncarcinogens are chronic reference doses (RfDs). Toxicity criteria, including toxicity and dose conversion factors for each noncarcinogen, chemical carcinogen, and radionuclide are provided in the CRA Methodology (DOE 2004a). A toxicity assessment for the WAEU was not conducted, because no COCs were selected for any medium in the WAEU and quantitative risk assessment is not necessary.

5.0 HUMAN HEALTH RISK CHARACTERIZATION

In the risk characterization, health effects from exposure to carcinogens and noncarcinogens are estimated. The chemical-specific intakes for carcinogens are multiplied by the applicable chemical-specific dose-response factors to estimate the cancer risk for an individual over a lifetime of exposure. The intakes are compared with RfDs to estimate health effects from exposure to noncarcinogens. Additional details regarding this approach are provided in the CRA Methodology (DOE 2004a).

A risk characterization for the WAEU was not performed because no COCs were selected for this EU.

6.0 UNCERTAINTIES ASSOCIATED WITH THE HUMAN HEALTH RISK ASSESSMENT

The following potential sources of uncertainty may impact the results of the HHRA:

- The adequacy and quality of the available data;
- Exposure and toxicity assumptions used in the development of PRGs;
- Methods and data used in the background comparison steps; and
- Assumptions and information used in the professional judgment screening step.

6.1 Uncertainties Associated with the Data

The sampling and analyses conducted in surface soil, subsurface soil, sediment, surface water and groundwater at the WAEU are considered adequate for the characterization of the WAEU. The density of surface soil samples collected in this area (that is, one five-sample composite per 30 acre square) is in agreement with the sampling and analysis requirements for the BZ (DOE 2004a and 2004b). Samples were collected at several different times from two sediment sampling stations and from three surface water locations. Samples from eight groundwater locations and one subsurface soil location were analyzed. The sampling results are generally homogeneous and do not indicate the presence of Site-related contamination. Subsurface sampling is sufficient because of the lack of contaminant sources and surface soil contamination in the WAEU. The sampling density and frequency for the WAEU is considered sufficient for the detection of any impacts from RFETS operations.

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Surface water, sediment, and subsurface soil samples available for the WAEU were collected from 1991 through 1995. Therefore the samples are representative of the area and sufficient for risk assessment.

Another source of uncertainty in the data is the relationship of detection limits to the PRGs. The detection limits were appropriate for the analytical methods used. This is examined in greater detail in Appendix A.

6.2 Uncertainties Associated with Screening Values

The COC screening analyses utilized Site-specific PRGs based on a WRW scenario. The assumptions used in the development of these values were conservative. For example, it is assumed that a future WRW will consume 100 mg of soil/sediment on 230 days a year for 18.7 years. In addition, a WRW is assumed to be dermally exposed and to inhale soil particles in the air. These assumptions are likely to overestimate actual exposures to surface soil for WRWs in the WAEU, because a WRW will not spend 100 percent of their time in this area. Exposure to subsurface soil is assumed to occur on 20 days per year. The WRW PRGs for subsurface soil are also expected to adequately estimate potential exposures, because it is not likely that a WRW will excavate extensively in the WAEU.

There is also uncertainty associated with the PRG values, because of the toxicity criteria that are used in their development. The sources of the toxicity criteria are discussed in the CRA Methodology (DOE 2004a). Generally, a large source of uncertainty is inherent in the derivation of toxicity criteria (that is, RfDs and CSFs). The main sources of potential error in the derivation of toxicity criteria include extrapolation from animal data to humans and the assumption of linearity in carcinogenic dose response relationships. However, the safety factors that are incorporated into toxicity criteria are more likely to result in an overestimation rather than underestimation of potential cancer and noncancer risks. The PRGs are therefore expected to be protective of WRW in the WAEU.

6.2.1 Potential Contaminants of Concern without Preliminary Remediation Goals

Detected PCOCs for which no PRGs are available in surface water include lead and oil/grease. The mean plus two standard deviations background concentration for lead in surface water (0.007 mg/L) is slightly higher than the average detected concentration of lead in surface water at the WAEU (0.006 mg/L). The EPA drinking water action level (AL) is 0.015 mg/L (EPA 2004). If the AL is calculated based on the estimated WRW surface water incidental ingestion rate of 0.03 L/day rather than the drinking water ingestion rate of 2 L per day, the surface water AL would be 1 mg/L. This margin of safety indicates that there is little uncertainty associated with the use of the surrogate screening value for lead.

Oil and grease were detected in five of 15 surface water samples at concentrations ranging from 600 to 17800 ug/L. The mean concentration for WAEU surface water, using one half the detection limit for non-detects was 4667 ug/L. Three of the surface water samples containing oil and grease were collected from Lindsay Branch (Location SW134 in Figure 1.5) in February, June, and December of 1992. The two other surface water samples were collected from the gravel pits that outfall to Rock Creek (Location

SW006 on Figure 1.5) and from the Upper Church Ditch (Location SW007 on Figure 1.5) in March 1993. The source of the oil and grease in surface water in the WAEU is not known.

The lack of a PRG and potential quantitative evaluation for oil and grease in surface water at the WAEU is not believed to have a significant impact on the results of the HHRA (no significant human health impacts expected) because other petroleum-related organics that are known to be toxic, such as benzene, toluene, ethylbenzene, xylene, or polyaromatic hydrocarbons were not detected in the surface water.

6.2.2 Eliminating Potential Contaminants of Concern Based on Professional Judgment

Arsenic in surface soil was eliminated as COCs based on professional judgment. There is no identified source in the WAEU and the slightly elevated median value of the WAEU data is most likely due to natural variation. Any risks due to arsenic are well within the background range for the western U.S.

6.2.3 Uncertainties Evaluation Summary

Uncertainties associated with the data and the COC screening process have been evaluated previously. This evaluation shows that there is reasonable confidence in the conclusion that the WAEU has not been affected by Site activities and there are no human health contaminants of concern for the WAEU.

7.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ERA portion of the CRA Methodology (Section 7.0) presents a process to identify ecological contaminants of interest (ECOIs) that should be evaluated as ecological contaminants of potential concern (ECOPCs) in a detailed risk characterization. The ECOPC identification process streamlines the ecological risk characterization for each EU by focusing the assessment on those chemicals that are present in the EU at concentrations of potential concern for the ecological receptors in the EU (Figure 7.1).

The ECOPC identification process differs from a traditional screening level ERA in that it includes additional evaluation steps that may eliminate contaminants from the list of ECOIs. The process used in the CRA is illustrated on Figure 7.1 and consists of two separate evaluations, one for PMJM and one for non-PMJM receptors. The ECOPC identification process for the PMJM is more stringent than for other receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (DOE 2004a).

The first step is termed the screening step and provides a comparison of MDCs to no-observed-adverse-effect-level (NOAEL) ecological screening levels (ESLs). NOAELs are concentrations at which no effects to either individual receptors or populations of receptors are predicted. Using these stringent criteria for species of special status, such as the PMJM, ensures the protection of the individuals as well as the local populations. If an ECOI concentration exceeds the appropriate NOAEL ESL, the second phase of the ECOPC identification process is initiated. If no ESL is available, the ECOI is identified

as an ECOI of uncertain toxicity. The screening step is identical for both the PMJM and non-PMJM receptors. The ESLs identified in Appendix B of the CRA Work Plan are used in the ECOPC identification process as shown on Figure 7.1.

The second step is a comparison to Site background concentrations. This is performed to determine if risk characterization is warranted. The statistical analyses used in this step are discussed in the CRA Methodology (DOE 2004a). Background data used for the comparisons are provided in Volume 2 of the CRA. At this point, those EOIs that both exceed the PMJM ESL and are shown to be greater than background, are identified as ECOPCs for the PMJM.

For the non-PMJM receptors, the ECOPC identification process continues as follows (Figure 7.1):

- Evaluation of detection frequency (greater or less than 5 percent);
- Comparison of the WAEU data to background;
- A professional judgment evaluation – using a weight of evidence approach that includes past industrial use, current land use, and other pertinent information regarding the ecology of the WAEU; and
- Comparison of calculated exposure point concentrations (EPCs) to threshold ESLs (tESLs) or if a tESL cannot be calculated, to NOAEL ESLs.

Two different EPCs are calculated for each ECOI that pass through the screening, frequency of detection, background, and professional judgment steps. The 95th UCL is calculated for the wide ranging receptors (coyote and mule deer) and the 95th UCL of the 90th percentile is calculated for receptors with small home ranges (small mammals, birds, and terrestrial plants and invertebrates).

The tESLs represent media concentrations that could represent a threshold level for potential effects to the individual receptor or population of receptors. The geometric mean between the lowest bounded lowest-observed-adverse-effect-level (LOAEL) for growth, reproduction, and mortality endpoints (bounded LOAELs are those that have a corresponding NOAEL from the same study) and the highest NOAEL that is lower than the lowest bounded LOAEL was calculated and used as the tESL for those ECOIs that had toxicity data of sufficient quality, as defined in Appendix B of the CRA Methodology (DOE 2004a).

A more detailed discussion of the ECOPC screening procedure and the assumptions inherent in this procedure is provided Section 7.3 of in the CRA Methodology (DOE 2004a). ESLs for each ECOI are also identified in this document.

7.1 Data Used in the Ecological Risk Assessment

A description of the environmental data for the WAEU used in the ERA is provided in Section 1.5 (Tables 1.2 and 1.4). The following WAEU data are used in the ERA:

- Ten surface soil samples (analyzed for inorganics and radionuclides); and
- Two subsurface soil (< 8 ft) samples, (analyzed for inorganics).

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Only subsurface soil up to 8 ft deep is considered in the ERA, because 8 ft is the assumed maximum depth to which prairie dogs can dig (DOE 2004a). A data summary with the frequency of detection, and minimum and maximum detections is provided in Table 1.2 for surface soil and Table 1.4 for subsurface soil < 8ft.

Sediment and surface water data for the WAEU were collected (Section 1). These data are evaluated for the ERA in Volume 15 of the CRA.

7.2 Identification of Ecological Contaminants of Potential Concern for the Preble's Meadow Jumping Mouse in Surface Soil

7.2.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The PMJM habitat and surface soil sampling locations within the WAEU are shown on Figures 1.4 and 1.5, respectively. No surface soil samples were collected within PMJM habitat in the WAEU. However, it can be reasonably assumed that concentrations in PMJM habitat are similar to those elsewhere in the WAEU, and chemical concentrations across the WAEU are generally homogeneous.

The maximum detected concentrations of ECOIs in surface soil in the WAEU are compared to NOAEL ESLs for the PMJM in Table 7.1. The MDCs in surface soil exceeded the NOAEL for the following chemicals: arsenic, nickel, vanadium, and zinc. These chemicals are retained as ECOIs for a comparison to background concentrations.

NOAEL ESLs for the PMJM are not available for aluminum, iron, silver, and titanium. These chemicals will be discussed in the uncertainty section (Section 11.3) as ECOIs with uncertain toxicity (CRA Methodology [DOE 2004a] Figure B-1).

7.2.2 Preble's Meadow Jumping Mouse Surface Soil Background Comparison

The background comparison is the final step in the ECOPC identification process for the PMJM receptor (Figure 7.1). The background evaluation for ECOIs consists of:

- Distribution tests for the EU and background data;
- Selection of a statistical test based on the data distributions; and
- Statistical comparison of the two datasets.

The results of these analyses for each remaining ECOI are presented in Tables 7.2 and 7.3. The *t*-test indicated that the concentrations of nickel, vanadium and zinc in surface soil at the WAEU were not statistically different from background surface soil concentrations (that is, p-value less than 0.9). These chemicals are eliminated from further evaluation.

The WAEU median arsenic surface soil concentration was shown to be statistically greater than the background median with the WRS test. However the quantile and slippage tests both showed arsenic to be in the same population as background.

With the exception of one data point, the arsenic concentrations in all surface soil samples were less than 10 mg/kg, ranging from 3.6 to 9.3 mg/kg with a concentration of 22 mg/kg in one sample. The WAEU and background datasets are otherwise very similar

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as is shown the box plot in Figure 2.3 and by the quantile and slippage tests (see discussion in Section 2.2.4).

Based on these background comparisons and the fact that arsenic in the WAEU is in the low range for soils of the western U.S. (Shacklet and Boerngen 1984), arsenic is not considered an ECOPC for the PMJM.

7.3 Identification of Ecological Contaminants of Potential Concern for Non-Preble's Meadow Jumping Mouse Receptors in Surface Soil

7.3.1 Comparison with No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process for non-PMJM receptors, the MDCs of ECOIs in surface soil are compared to receptor-specific NOAEL ESLs. NOAEL ESLs for surface soil were developed for three receptor groups, terrestrial vertebrates, terrestrial invertebrates and terrestrial plants. The NOAEL ESLs for terrestrial vertebrates in surface soil are compared to MDCs in surface soil in Table 7.4. The NOAEL ESLs for terrestrial invertebrates and plants are compared to MDCs of ECOIs in Table 7.5.

The results of the NOAEL ESL screening analyses for all receptor types are presented in Table 7.6. Chemicals bolded in Table 7.6 are further evaluated in the ECOPC identification step and include aluminum, arsenic, boron, chromium, copper, lead, lithium, manganese, mercury, nickel, thallium, vanadium, and zinc.

NOAEL ESLs were not available for several ECOI/receptor pairs. Only iron and titanium lacked an ESL for all four of the Non-PMJM receptors. For mammalian receptors, no ESLs were available for aluminum, iron, silver and titanium. For avian receptors, no ESLs were available for aluminum, antimony, beryllium, iron, lithium, silver, strontium, thallium, and titanium. For terrestrial plants, no ESLs were available for iron, lithium, strontium, and thallium. Finally, for terrestrial invertebrates, no ESLs were available for aluminum, boron, cobalt, iron, lithium, manganese, molybdenum, silver, strontium, thallium, tin, titanium and vanadium. These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity along with the potential impacts to the risk assessment (Section 11.3).

7.3.2 Non-Preble's Meadow Jumping Mouse Surface Soil Detection Frequency Evaluation

The ECOPC identification process for Non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step (Figure 7.1). If the detection frequency is less than 5, the ECOI is eliminated from further evaluation. The detection frequencies for chemicals in surface soil are presented in Table 1.2. None of the chemicals in surface soil at the WAEU that was retained after the NOAEL ESL screening step had a detection frequency of less than 5 percent. Therefore, frequency of detection is not further evaluated for surface soil in the WAEU.

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7.3.3 Non-Preble's Meadow Jumping Mouse Surface Soil Background Comparisons

A background comparison for the all ECOIs with background data available (Section 1.6) was performed and the results of these analyses for each remaining ECOI are presented in Tables 7.7 and 7.8. The *t*-tests indicate that the mean concentrations of lead, manganese, nickel, vanadium, and zinc in surface soil at the WAEU are not statistically different than the means for the background surface soil dataset ($p < 0.9$). The WRS tests indicate that the median concentrations of copper and mercury in surface soil at the WAEU are not statistically different than the means for the background surface soil dataset ($p < 0.9$). These chemicals are eliminated from further evaluation as ECOPCs.

The following chemicals were not eliminated by these tests: aluminum, arsenic, chromium, lithium, and thallium. These chemicals are retained for further analysis based on the background comparison. The quantile and slippage tests both show that aluminum, arsenic, chromium, and lithium in surface soils are in the same population as background. The box plots in Figures 2.3, 7.2 and 7.3support this conclusion. Therefore, these ECOIs are not assessed further.

No background data were available for boron and a statistical background comparison is not possible for thallium because of the high number of non-detects in the dataset. Therefore, boron and thallium are also retained for additional evaluation.

7.3.4 Non-Preble's Meadow Jumping Mouse Surface Soil Professional Judgment Evaluation

Professional judgment evaluation takes into account factors that could indicate that it may be necessary to further evaluate ECOIs detected at concentrations greater than NOAEL ESLs and statistically greater than the range of background concentrations (Figure 7.1). No background data are available for boron. Historical evidence indicates that there were no RFETS-related operations at the WAEU or in the vicinity of the WAEU that could be linked to the presence of these ECOIs (DOE 1992). Additional evaluations that discuss potential similarities between the WAEU and the background dataset or present other arguments for not further evaluating boron, and thallium are presented in the following paragraphs.

The data for thallium are shown in Table 7.9. Thallium was detected once in WAEU surface soils and not at all in background surface soil. The detected concentration in the WAEU sample was 1.3 mg/kg. This concentration is at the bottom of the observed range in the U.S. (2.4 to 37 mg/kg) and well below the arithmetic mean of background concentrations in soils typical of the Western U.S. (9.8 mg/kg) (Shacklette and Boerngen 1984). The single detect is not indicative of thallium contamination in the WAEU. Thallium is not evaluated as an ECOPC.

No background data are available for boron. Statistical analyses for comparison of WAEU boron concentrations to background concentrations were not performed. Boron concentrations in surface soils at the WAEU are well below those identified by Shacklette and Boerngen (1984) for soils typical of the Western U.S. and also those reported in a background study for California (University of California 1996). Shacklette

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and Boerngen (1984) list the range of boron concentrations in western soils as less than 20 to 50 mg/kg. The maximum detected concentration of boron in WAEU soils (7.1 mg/kg) is well below this range. The comprehensive study on background metals in California reported boron concentrations ranging from 1 to 79 mg/kg with a geometric mean concentration of 14 mg/kg (University of California 1996). This is nearly twice the maximum detected concentration in WAEU surface soils. There is no evidence of impact from RFETS-related operations to WAEU surface soil. Boron is eliminated from further consideration based on this background assessment and historical evidence.

7.4 Identification of Ecological Contaminants of Potential Concern for Vertebrates in Subsurface Soil

Subsurface soil sampling locations for soil collected at a starting depth of 0 to 8 ft in the WAEU are identified on Figure 1.5. Soil in the area where the subsurface soil samples were collected has subsequently been impacted by mining activities and the data from the impacted soil are not representative of current conditions. For purposes of conservatism, the subsurface soil data are assessed as though no disturbance has occurred. A data summary for subsurface soil < 8 ft deep is presented in Table 1.3.

7.4.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The CRA Methodology (DOE 2004a) indicates that subsurface soils must be evaluated for those ECOIs that show greater concentrations in subsurface (< 8 ft.) than in surface soil. Given the limited amount of subsurface soil, a comparison of the two datasets provides minimal information that is useful to the ERA. However, because there are no known source areas in the WAEU and subsequently no clear exposure pathway, the data are adequate for screening.

The initial screening step for the WAEU was conducted using the MDCs of ECOIs in subsurface soil, regardless of their relationship to surface soil. MDCs are compared to NOAEL ESLs for burrowing receptors (Table 7.10).

Only manganese had a maximum subsurface soil concentration greater than the NOAEL ESL for the prairie dog. Therefore, manganese was further evaluated in the ECOPC identification process.

NOAEL ESLs are not available for aluminum and iron but both are presented as ECOIs with uncertain toxicity in the uncertainty analysis (Section 11.3). A background comparison for manganese was presented in Table 7.2.

7.4.2 Subsurface Soil of Detection Frequency Evaluation

No frequency of detection evaluation was conducted, because only two subsurface soil samples are available in the WAEU.

7.4.3 Subsurface Soil Background Comparison

Manganese was detected in both subsurface soil samples in the WAEU. Statistical comparisons for subsurface soil are not appropriate because only two data points are

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available. However, comparison of the WAEU and background data indicate that the WAEU manganese concentrations fall within those for background (Figure 7.4).

A box plot for manganese shows that the WAEU data are near the bottom of the range of detected concentrations of manganese in background subsurface soil (Figure 7.4). Manganese concentrations in the 99 background samples ranged from 37 to 3300 mg\kg. The two detected WAEU concentrations were 148 and 295 mg/kg. The means for the WAEU and background data are similar, 240.3 and 217.6 mg/kg, respectively. This information combined with the lack of evidence for RFETS-related manganese sources in the WAEU indicate that manganese in subsurface soils does not require further evaluation as an ECOPC.

7.4.4 Subsurface Soil Professional Judgment

No professional judgment evaluation is necessary for subsurface soils in the WAEU because there were no ECOIs retained beyond the background analysis step.

7.5 Summary of Ecological Contaminant Of Potential Concern

ECOIs in surface and subsurface soil in the WAEU were evaluated in the ECOPC identification process. None of these chemicals was retained past the professional judgment step of the ECOPC identification process. Therefore, no ECOPCs were identified for the WAEU.

8.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification steps did not identify any ECOPCs for either the surface or subsurface soil in the WAEU. Therefore, no exposure assessment for the WAEU is indicated.

9.0 ECOLOGICAL TOXICITY ASSESSMENT

The ECOPC identification steps did not identify any ECOPCs for either surface or subsurface soils in the WAEU. Therefore, no additional toxicity assessment for the WAEU is indicated.

10.0 ECOLOGICAL RISK CHARACTERIZATION

Characterization of risk focuses on the overall results for each assessment endpoint. This includes discussion of the potential for risk for each receptor group and level of biological organization (that is, individual or population level of protection), as appropriate for the assessment endpoints. As noted by EPA (1997b), a well-balanced risk characterization should "...present risk conclusions and information regarding the strengths and limitations of the assessment for other risk assessors, EPA decision-makers, and the public."

Risk characterization typically has two main components: risk estimation and risk description. The risk estimation summarizes the results of the analysis, identifies the ECOPCs and associated receptors, presents a range of potential risks, and identifies the specific locations where risk may be present. The risk description provides the context for

the analysis, including the proportions of habitats that are affected, and interpretation of overall results.

The following sections present the results of the ecological risk characterization for the WAEU grouped by receptor or assessment endpoint. The ECOPC identification process did not identify any ECOIs that require further risk characterization for discussion in the WAEU ERA (Section 7.0). Therefore, the risk characterization for the WAEU does not provide an additional evaluation of risk, but rather provides a summary of the ECOPC identification process for each receptor.

10.1 Preble's Meadow Jumping Mouse

Areas of PMJM habitat are present in a small area in the WAEU (Figure 1.4). No data are available from within PMJM habitat (Section 7.2). Using a conservative approach, MDCs from all surface soil samples throughout the WAEU were used to identify ECOPCs for the PMJM regardless of the habitat associated with the sample locations. Only maximum EU-wide detections of arsenic, nickel, vanadium and zinc exceeded the NOAEL ESL for the PMJM. All four of these ECOIs were either found to be within background concentrations and removed from further consideration as ECOPCs. Therefore, it is unlikely that PMJM receptors potentially inhabiting the WAEU are at risk from exposure to ECOIs.

10.2 Herbivorous Small Mammals

The only the MDC of arsenic exceed the NOAEL ESL for the herbivorous deer mouse. Arsenic was, eliminated from further consideration based on the background comparison. It is unlikely that populations of herbivorous small mammals in the WAEU are at risk.

10.3 Insectivorous Small Mammals

Chromium, nickel, vanadium, and zinc MDCs exceed NOAEL ESLs for the insectivorous deer mouse receptor. All of the ECOIs were eliminated from further consideration as ECOPCs based on comparisons to background concentrations. Therefore, no risks are predicted to the insectivorous small mammal feeding guild based on ECOIs at the WAEU.

10.4 Burrowing Small Mammals

Only arsenic and manganese MDCs in surface soils exceed the screening ESL for the prairie dog. Both were subsequently removed from the list of ECOPCs because they were shown to be statistically within the range of background concentrations. No risks are predicted to the population of burrowing small mammals in the WAEU.

Only manganese was detected at concentrations in excess of the screening level ESLs in subsurface soils for the prairie dog receptor. Manganese was identified as being within the range of background subsurface soil concentrations and was eliminated from further consideration as ECOPCs. Therefore, no risks are predicted to burrowing small mammals from ECOIs at the WAEU.

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10.5 Ruminant Mammals

Only arsenic was detected at a concentration that exceeded NOAEL ESLs in the WAEU surface soils for the mule deer receptor. Arsenic was removed from further consideration as an ECOPC based on a statistical comparison to background. Therefore, no ECOPCs were identified for the mule deer and no risk is predicted to ruminant mammals based on exposure to ECOIs in the WAEU.

10.6 Mammalian Predators

The MDC of nickel in the WAEU surface soils was greater than the NOAEL ESL for both the insectivore and generalist coyote feeding guilds. Nickel was eliminated from further consideration as an ECOPC based on a comparison with the background data for surface soils. The range of concentrations in the WAEU was shown not to be significantly different from the range of background concentrations. No risk to the mammalian predator, regardless of feeding guild, is predicted from ECOIs in the WAEU.

10.7 Herbivorous Small Birds

The MDC of arsenic (22 mg/kg) slightly exceeded the NOAEL ESL for the herbivorous mourning dove receptor (20 mg/kg). Arsenic was subsequently eliminated from further consideration as an ECOPC based on a comparison to background values. Given that the MDC was essentially equal to the conservative screening level ESL, no risk to the population of herbivorous small birds is predicted from exposure to arsenic in WAEU surface soil.

10.8 Insectivorous Small Birds

MDCs for chromium, copper, lead, mercury, nickel, and zinc exceeded the NOAEL ESLs for the insectivorous mourning dove receptor. Comparison of the WAEU datasets to the background dataset indicated that all ECOIs were within the range of background concentrations. It is unlikely that any risks above what could reasonably be expected in areas outside of RFETS would occur to insectivorous small birds from exposures to ECOIs in the WAEU.

10.9 Avian Predators

Only the MDC of chromium exceeded the NOAEL ESL for the American kestrel. Chromium was eliminated from further consideration as an ECOPC based on a comparison to background surface soil values. Therefore, no risks are predicted to avian predators using the WAEU.

10.10 Terrestrial Plants

Aluminum, arsenic, boron, chromium, lithium, thallium, and vanadium were carried through the screening step for terrestrial plants. Aluminum, arsenic, chromium, lithium, thallium and vanadium were shown to be within the range of background concentrations. Boron was eliminated from further consideration as ECOPCs based on professional judgment. None of the ECOIs is predicted to cause risk to the terrestrial plant communities in the WAEU.

10.11 Terrestrial Invertebrates

Only chromium was detected at a concentration that exceeded the screening ESL for terrestrial invertebrates. The range of chromium concentrations in the WAEU was found to be very similar to the range of background concentrations. Therefore, no risk is predicted to terrestrial invertebrates from chromium in surface soil in the WAEU.

11.0 UNCERTAINTIES ASSOCIATED WITH THE ECOLOGICAL RISK ASSESSMENT

There are a number of uncertainties in the ecological risk assessment process. Many of these uncertainties are discussed in Volume 2 of the CRA. This section focuses on uncertainties associated specifically with the data collected in the WAEU and the analyses performed for the WAEU. Uncertainties associated with the development of ESLs, although not specific to the WAEU, are also briefly discussed, because they are an important element of the ECOPC identification process.

The approach presented in the CRA Methodology (DOE 2004a) is conservative. The conclusions reached in this report are also conservative and are adequately protective of potential ecological receptors in the WAEU. The remainder of this section focuses on the uncertainties that are specifically associated with the WAEU.

11.1 Uncertainties Associated with Data Adequacy and Quality

Sections 1.3 and 1.4 discuss the general data adequacy and data quality for the WAEU. No soils data have been identified in the areas of the WAEU designated as PMJM habitat, as shown on Figure 1.4. As a result, no analyses specific to the PMJM habitat were conducted for the WAEU. This introduces uncertainty into the risk characterization process for the PMJM, but it can be assumed that the uncertainty is minimal for the following reasons.

First, all of the ECOIs that were greater than PMJM NOAEL ESLs in all surface soil samples, regardless of habitat, were either found to be within the range of RFETS-specific background concentrations or were eliminated based on professional judgment. Secondly, the professional judgment analysis took into account the lack of suspected source areas in the WAEU and the lack of suspected contamination. Therefore, the assumption that no risks are predicted to the PMJM receptors that may inhabit the designated PMJM habitat areas in the WAEU is reasonable. Subsurface soil data were also limited in number and extent. However, Section 1.3 indicated that the data are adequate for the CRA because no site-related activities have occurred in the WAEU.

11.2 Ecological Contaminants of Potential Concern Identification Process

The ECOPC identification process for surface and subsurface soils in the WAEU consisted of an initial comparison of MDCs to conservative NOAEL-based ESLs for different receptor groups and subsequent background, source analyses and comparisons. The conservative assumptions associated with these steps minimized the potential for eliminating ECOIs of toxicological significance for the WAEU or significantly above background concentrations.

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11.2.1 Selection of Representative Receptors

ESLs were developed for several representative species that are intended to represent the various groups of species or feeding guilds potentially inhabiting RFETS. There are uncertainties associated with the selection of the representative receptors from the group of species identified at RFETS based on field observations. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within the WAEU, their potential to come into contact with ECOIs, their potential sensitivities to ECOIs, and the amount of life history and behavioral information available. The use of these criteria decreases the uncertainty associated with receptor selection.

11.2.2 Development of No Observed Adverse Effect Level Ecological Screening Levels

ESLs are typically based on information gained from laboratory and other carefully controlled experimental exposures described in the literature. This information is then used to extrapolate conditions likely to exist in the natural environment. The laboratory information often does not provide adequate background for these extrapolations. Consequently, assessment factors are often used to compensate for the many uncertainties inherent in the extrapolation from laboratory effects data to effects in natural ecosystems (Warren-Hicks and Moore 1998). Uncertainties arise, for example, when extrapolations are made from (Calabrese and Baldwin 1993):

- Acute to chronic endpoints;
- One life stage to an entire life cycle;
- Individual effects to effects at the population level or higher;
- One species to many species;
- Laboratory to field conditions;
- One to all exposure routes;
- Direct to indirect effects;
- One ecosystem to all ecosystems; and/or
- One location or time to others.

The net effect of these uncertainties may result in either an overestimate or underestimate of risk, depending on RFETS-specific conditions, the types of receptors included in the evaluation, and the particular ECOIs.

The CRA Methodology (DOE 2004a) presents a strict set of rules for applying toxicity data to develop ESLs for the ECOIs and to minimize uncertainty related to the extrapolations listed above. No procedures for the identification of toxicity data and eventual development of ESLs can eliminate the uncertainty inherent in the overall development process for ESLs. However, a consistently conservative bias helps to ensure that risks are not underestimated. In addition, the process for ESL calculation represents a consensus among EPA, CDPHE, USFWS, and DOE and represents the best method to establish the goals of the CRA.

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11.3 Lack of Toxicity Data for Ecological Contaminant of Interest Detected at the Western Area Exposure Unit.

Several ECOIs were detected in the WAEU that did not have adequate toxicity data for the derivation of ESLs (Appendix B of the CRA Methodology). Those ECOIs are listed in Table 11.1.

The background analysis for the chemicals listed in Table 11.1 indicated that only aluminum and lithium may be present at concentrations greater than those found in background areas. However, subsequent data analyses suggested that the WAEU and background data for these chemicals had similar confidence intervals, or UCLs or both, and means. In addition, no evidence for a RFETS-related origin for these ECOIs in the WAEU was identified. Therefore, aluminum and lithium were eliminated from further consideration as ECOPCs.

The potential for risk caused by these ECOIs is uncertain. However, given that there are no sources of contamination to the surface or subsurface soils in the WAEU, and the lack of risk from the ECOPCs with adequate toxicity data, no risk is expected from the previous list of ECOIs.

Background data are not available for boron and titanium. These chemicals were not further evaluated, because there is no evidence for a RFETS-related source.

12.0 SUMMARY AND CONCLUSIONS

12.1 Human Health

A risk characterization for the WAEU was not performed because no COCs were selected. The COC screening analyses compared maximum detected concentrations of chemicals in WAEU media to PRGs for the WRW receptor. Chemicals that passed the screen were compared to background concentrations and evidence for historic sources in or near the WAEU. No COCs were selected. There are no significant human health risks from RFETS-related operations at the WAEU, and health risks to the WRW and WRV are expected to be within the range of background risks.

12.2 Ecological Risk

The DQA indicated that the data available for the WAEU CRA were adequate for the assessment and no issues of concern were identified in the uncertainty section (Section 11.0) of this report.

No risk above what would be expected to be encountered in background areas in the vicinity of the WAEU are predicted for any of the receptors evaluated. All ECOIs were eliminated from further consideration as ECOPCs based on comparisons of MDCs to NOAEL ESLs, background comparisons, or professional judgment.

No data specific to PMJM habitat are available. However, as discussed in Sections 7.3 and 11.2, no RFETS-related risks are expected and the uncertainty involved in the qualitative analysis is minimal.

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Table 1.1 Number of Samples in Each Medium by Analyte Suite

Analyte Suite	Surface Soil 0-0.5 ft	Sediment	Subsurface Soil 0.5-8.0 ft	Surface Water	Groundwater
Inorganics	10	10	2	69	81
Organics	0	10	0	19	97
Radionuclides	10	8	0	15	61

Table 1.2 Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	5.2 - 5.8	10	100	18000	8200	13520	3168
Antimony	0.3 - 0.34	10	20	0.6	0.34	0.22	0.15
Arsenic	0.86 - 0.97	10	100	22	3.6	8.48	5.07
Barium	0.39 - 0.44	10	100	140	68	109	24.5
Beryllium	0.11 - 0.12	10	40	0.52	0.25	0.36	0.10
Boron	1.1 - 1.2	10	100	7.1	2.8	5.11	1.20
Calcium	7.4 - 8.4	10	100	4600	880	2308	943
Chromium	0.16 - 0.18	10	100	17	8.1	13.3	2.65
Cobalt	0.19 - 0.22	10	100	6.4	3.8	5.04	0.93
Copper	0.048 - 0.054	10	100	13	5.2	9.77	2.20
Iron	1.5 - 1.7	10	100	16000	8900	13190	2414
Lead	0.29 - 0.32	10	100	48	9.9	30.5	11.4
Lithium	0.52 - 0.58	10	100	12	5.7	9.28	1.74
Magnesium	8 - 9	10	100	2500	1000	1920	432
Manganese	0.18 - 0.21	10	100	320	150	2600	55.8
Mercury	0.0073 - 0.0083	10	100	0.03	0.02	0.03	0.003
Molybdenum	0.31 - 0.35	10	100	0.91	0.32	0.61	0.20

Table 1.2 Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Nickel	0.21 - 0.23	10	100	11	4.9	8.79	1.62
Potassium	38 - 43	10	100	2800	1200	2050	455
Silica	4.6 - 5.2	10	100	790	670	735	42.5
Silver	0.083 - 0.093	10	10	0.12	0.12	0.09	0.05
Sodium	140 - 150	10	20	200	140	91.5	43.78
Strontium	0.062 - 0.07	10	100	24	9.6	20.3	4.20
Thallium	0.96 - 1.1	10	10	1.3	1.3	0.57	0.26
Titanium	0.093 - 0.1	10	100	320	150	236	58.2
Vanadium	0.49 - 0.55	10	100	34	19	28	5.0
Zinc	0.48 - 0.54	10	100	50	21	37	9.0
Radionuclides[b] (pCi/g)							
Americium-241	0.131 - 0.296	10	100	0.08	-0.016	0.028	0.034
Plutonium-239/240	0.0582 - 0.275	10	100	0.25	-0.078	0.066	0.094
Uranium-234	0.136 - 0.423	10	100	1.27	0.71	0.888	0.203
Uranium-235	0.214 - 0.482	10	100	0.189	-0.011	0.084	0.084
Uranium-238	0.194 - 0.423	10	100	1.7	0.678	0.985	0.331

a – For inorganics the value includes ½ the detection limits for nondetects, for radionuclides all reported values are included.
b - All radionuclide values are considered detects.

Table 1.3 Summary of Detected Analytes in Sediment

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration [a]	Standard Deviation [a]
Inorganics (mg/kg)							
Aluminum	4.8 - 40	10	100	19400	2390	9521	6050
Antimony	3 - 12	10	20	12.4	11.1	5.1	4.0
Arsenic	0.27 - 2	10	100	5.3	1.4	3.2	1.62
Barium	1.2 - 40	10	100	244	22.2	103	71
Beryllium	0.11 - 1	10	60	1.4	0.27	0.47	0.39
Cadmium	0.51 - 1.3	10	30	1.3	0.41	0.55	0.34
Chromium	0.56 - 2	10	100	24.8	2.1	10.5	6.9
Cobalt	0.6 - 10	10	100	10.1	2.6	6.4	2.5
Copper	0.45 - 5	10	90	25.9	4.3	13.9	8.6
Iron	3.6 - 20	10	100	23400	4440	13093	6153
Lead	0.6 - 2.5	10	100	25.5	2.8	14.0	7.8
Lithium	1.5 - 20	10	100	20.3	2.7	8.4	6.0
Manganese	0.28 - 3	10	100	470	101	238	1212
Molybdenum	1.2 - 40	10	30	2.4	0.79	1.254	0.7
Nickel	1.3 - 8	10	90	17.6	3.1	9.4	5.1
Nitrate/Nitrite	0.02 - 2.8	10	60	76	0.3	15.1	29.2
Silver	0.62 - 2	9	11	2	2	0.6	0.6
Strontium	0.55 - 400	10	100	41.2	4.1	22.5	13
Thallium	0.41 - 2	10	10	0.4	0.4	0.3	0.1
Tin	2.2 - 40	10	30	17.5	3.6	7.3	7.2
Vanadium	0.49 - 10	10	100	51.9	8	26	13.4
Zinc	0.92 - 4	10	100	720	28.4	221	259
Organics (ug/kg)							
2-Butanone[b]	10 - 29	9	11	3	3	7.7	3.1
4-Methylphenol[b]	330 - 950	10	10	95	95	394	185
Benzoic Acid[b]	1600 - 4800	10	30	480	380	1442	937

Table 1.3 Summary of Detected Analytes in Sediment

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration [a]	Standard Deviation [a]
bis(2-Ethylhexyl)phthalate[b]	330 - 950	10	30	250	69	377	201
Di-n-butylphthalate[b]	330 - 950	10	40	150	52	288	186
Fluoranthene[b]	330 - 950	10	10	88	88	411	180
Pyrene[b]	330 - 950	10	10	61	61	409	186
Toluene[b]	5 - 14	10	10	2	2	4	1
Radionuclides[c] (pCi/g)							
Americium-241	0 - 0.015	8	100	0.087	-0.004	0.016	0.029
Cesium-137	0.05 - 0.48	8	100	1.498	0.002	0.382	0.507
Plutonium-239/240	0.002 - 0.014	8	100	0.04	0.002	0.016	0.011
Radium-226	0.19 - 1	4	100	1.800	0.39	1.06	0.693
Radium-228	0.33 - 1.76	4	100	4.100	0.94	2.41	1.39
Strontium-90	0.04 - 0.4	8	100	0.319	0.08	0.217	0.091
Tritium	211 - 420	8	100	0.44	-0.062	0.154	0.173
Uranium-234	0.014 - 0.044	8	100	3.079	0.63	1.78	0.891
Uranium-235	0 - 0.044	8	100	0.14	0.016	0.066	0.04
Uranium-238	0.008 - 0.062	8	100	2.81	0.65	1.68	0.893

a – For inorganics and organics the value includes ½ the detection limits for nondetects, for radionuclides all reorted alues re included.
b – All detections are "J" qualified, signifying that the reported result is an estimated value, below the method detection limit, but above the instrument detection limit.
c – All radionuclide values are considered detects.

Table 1.4 Summary of Detected Analytes in Subsurface Soil

Analyte	Reported Detection Limit	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	NA	2	100	15400	14300	12555	2819
Arsenic	NA	2	100	3.6	2.4	3.4	0.79
Barium	NA	2	100	64	50.2	57.7	6.7
Beryllium	NA	2	100	1.2	1.1	0.88	0.5
Chromium	NA	2	100	13.6	13.1	76.5	91.8
Cobalt	NA	2	100	7.9	7.5	10.4	3.7
Copper	NA	2	100	11	10.7	31.6	37.9
Iron	NA	2	100	18100	14400	23850	13391
Lead	NA	2	100	5.7	4.9	6.6	1.5
Lithium	NA	2	100	7.5	6.8	6.8	0.99
Manganese	NA	2	100	295	148	240	85.7
Nickel	NA	2	50	12.6	NA	8.28	6.12
Strontium	NA	2	100	45	25.3	35.2	13.9
Tin	NA	2	100	33.9	32.9	33.4	0.71
Vanadium	NA	2	100	36.1	26.5	31.3	6.79
Zinc	NA	2	100	26.9	20.4	23.7	4.6

[a] – For inorganics the value includes ½ the detection limits for nondetects.
NA – Not applicable..

Table 1.5 Summary of Detected Analytes in Surface Water

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/L)							
Aluminum	0.25 - 200	69	88	129	0.0202	6.8	18.8
Antimony	0.05 - 60	69	14	0.029	0.0004	0.007	0.007
Arsenic	0.32 - 200	68	38	0.017	0.001	0.004	0.01
Barium	0.02 - 200	69	100	0.63	0.024	0.10	0.09
Beryllium	0 - 5	69	23	0.0037	0.00004	0.0005	0.001
Cadmium	0.03 - 5	68	9	0.0038	0.00007	0.001	0.001
Calcium	1.6 - 5000	69	100	39.2	4.68	21.5	8.1
Cesium	0.1 - 1000	36	17	0.07	0.0007	0.12	0.12
Chloride	0.1 - 5	48	98	67	3	13	10.5
Chromium	0.05 - 10	69	48	0.247	0.00051	0.01	0.04
Cobalt	0.01 - 50	69	39	0.0193	0.00028	0.002	0.003
Copper	0.04 - 25	67	64	0.0484	0.00115	0.006	0.01
Cyanide	5 - 20	15	7	0.0024	0.0024	0.005	0.003
Fluoride	0.03 - 0.5	48	98	1	0.2	0.39	0.13
Iron	2.5 - 100	69	99	88.6	0.01029	4.64	12.8
Lead	0.03 - 150	66	65	0.0508	0.00012	0.006	0.01
Lithium	0.02 - 100	64	55	0.154	0.00128	0.007	0.02
Magnesium	0.08 - 5000	69	100	18.2	1.25	5.41	2.4
Manganese	0.01 - 15	69	99	0.492	0.001201	0.07	0.1
Mercury	0.014 - 0.2	61	13	0.00477	0.000035	0.0002	0.001
Molybdenum	0.03 - 200	66	36	0.0084	0.00095	0.003	0.002
Nickel	0.05 - 40	69	45	0.12	0.00141	0.01	0.02
Nitrate/Nitrite	0.02 - 1	18	61	2	0.06	0.44	0.6
Nitrite	0.02 - 0.05	13	78	0.058	0.058	0.02	0.01
Orthophosphate	0.02 - 0.05	16	25	0.58	0.02	0.06	0.14
Phosphorus	0.01 - 0.05	16	50	0.18	0.05	0.06	0.05

Table 1.5 Summary of Detected Analytes in Surface Water

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Potassium	0.35 - 5000	69	98	15.4	0.954	2.7	2.1
Selenium	0.2 - 150	68	25	0.019	0.0006	0.002	0.004
Silicon	15.2 - 555.6	40	100	177	0.87	11.3	29.3
Silver	0.03 - 10	69	4	0.0028	0.00006	0.001	0.001
Sodium	0.42 - 5000	69	100	33.4	1.92	16.9	6.5
Strontium	0.02 - 200	66	100	0.238	0.03	0.13	0.05
Sulfate	0.1 - 10	48	100	48	4	28.8	11.3
Thallium	0.05 - 350	68	12	0.007	0.0002	0.002	0.009
Tin	0.16 - 200	64	9	0.0042	0.001	0.005	0.006
Uranium, Total	2.7 - 28	7	29	0.0038	0.003	0.001	0.005
Vanadium	0.02 - 50	69	57	0.132	0.0004	0.014	0.028
Zinc	0.08 - 20	68	74	0.103	0.002	0.019	0.025
Organics (ug/L)							
2-Butanone[b]	10	15	7	3	3	4.9	0.52
Acetone	10	15	7	28	28	7.6	6.05
Methylene chloride	5	16	6	16	16	4.3	4.0
Oil and Grease	200 - 14500	15	33	17800	600	4667	5007
Radionuclides[c] (pCi/L)							
Americium-241	0 - 0.019	14	100	0.024	-0.001	0.005	0.008
Cesium-137	0.46 - 0.99	6	100	0.45	-0.558	0.07	0.35
Gross alpha	0.37 - 6	11	100	45	0.13	10.1	17.2
Gross beta	1 - 8	13	100	35	1.7	10.1	11.0
Plutonium-238	0.049 - 0.378	2	100	0.01343	0.001	0.007	0.009
Plutonium-239/240	0 - 0.257	15	100	0.043	0	0.006	0.01
Radium-226	0.16 - 0.5	3	100	4.9	-0.1	2.3	2.5
Strontium-90	0.21 - 0.835	8	100	2.172	0.14	1.2	0.74
Tritium	200 - 470	10	100	751	-32.9	166	231

Table 1.5 Summary of Detected Analytes in Surface Water

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Uranium-234	0.017 - 0.3	15	100	5.1	-0.056	0.92	1.45
Uranium-235	0 - 0.32	15	100	0.29	-0.00962	0.07	0.09
Uranium-238	0 - 0.26	15	100	4.9	0.059	0.9	1.4

a – For inorganics the value includes ½ the detection limits for nondetects, for radionuclides all reported values are included.
b – All detections are "J" qualified, signifying that the reported result is an estimated value, below the method detection limit, but above the instrument detection limit.
c – All radionuclide values are considered detects.

Table 1.6 Summary of Detected Analytes in Groundwater

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/L)							
Aluminum	0.0086 - 0.2	81	49	34.1	0.0121	3.78	6.99
Ammonia	0.05 - 50	19	26	3.549	0.029	13.4	39.3
Antimony	0.002 - 0.06	81	10	0.0325	0.0036	0.012	0.007
Arsenic	0.0007 - 0.01	81	25	0.0083	0.0011	0.001	0.001
Barium	0.0004 - 0.2	81	100	0.462	0.0115	0.092	0.080
Beryllium	0.0002 - 0.005	81	9	0.002	0.00055	0.001	0.000
Cadmium	0.0016 - 0.005	81	4	0.003	0.0011	0.001	0.001
Calcium	0.0034 - 5	81	100	67	12.1	22.2	9.2
Cesium	0.008 - 1	77	7	0.04	0.024	0.047	0.071
Chloride	0.2 - 5	51	88	23	1	6	6
Chromium	0.0018 - 0.01	80	26	0.0524	0.0021	0.007	0.012
Cobalt	0.0014 - 0.05	81	22	0.0272	0.003	0.004	0.004
Copper	0.0011 - 0.025	81	28	0.0434	0.001	0.006	0.008
Cyanide	0.005 - 0.1	47	6	0.00508	0.0014	0.003	0.002
Fluoride	0.1 - 0.5	53	96	1.5	0.16	0.474	0.36
Iron	0.0018 - 0.1	80	54	30.4	0.0086	3.75	6.96
Lead	0.0007 - 0.003	81	37	0.0204	0.0012	0.003	0.005
Lithium	0.001 - 0.1	81	51	0.0259	0.0011	0.006	0.005
Magnesium	0.012 - 5	81	99	11.6	0.5	4.5	2.3
Manganese	0.0005 - 0.015	81	65	1.93	0.00069	0.14	0.30
Mercury	0 - 0.0002	81	4.9	0.00045	0.00024	0.0001	0.0001
Molybdenum	0.0025 - 0.2	81	24	0.0531	0.002	0.011	0.016
Nickel	0.0037 - 0.04	81	26	0.0457	0.0025	0.010	0.009
Nitrate/Nitrite	0.02 - 1	55	91	13	0.03	2.4	2.4
Potassium	0.36 - 5	81	78	6.44	0.438	1.59	1.51

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Table 1.6 Summary of Detected Analytes in Groundwater

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Selenium	0.0011 - 0.005	81		0.0042	0.001	0.001	0.001
Silver	0.002 - 0.01	81	2.5	0.0054	0.0042	0.001	0.001
Sodium	0.01 - 5	81	100	33.5	7.35	14.9	7.2
Strontium	0.0002 - 0.2	81	100	0.411	0.0717	0.147	0.073
Sulfate	0.5 - 50	53	100	130	7	32	30
Thallium	0.001 - 0.01	81	3.7	0.0093	0.0037	0.001	0.001
Tin	0.0073 - 0.2	81	11	0.0678	0.0076	0.013	0.011
Vanadium	0 - 0.05	81	46	4.1	0.002	0.06	0.46
Zinc	0 - 0.02	81	49	0.201	0.0015	0.024	0.033
Organics (ug/L)							
1,1,2,2-Tetrachloroethane[b]	0.2 - 5	54	1.9	1	1	1.3	1.2
1,1,2-Trichloroethane[b]	0.3 - 5	54	1.9	0.7	0.7	1.3	1.1
4-Methyl-2-pentanone[b]	10 - 10	25	4	3	3	4.9	0.4
bis(2-Ethylhexyl)phthalate	10 - 10	8	62	57	1	10.5	18.8
Bromoform[b]	0.2 - 5	53	1.9	0.6	0.6	1.3	1.2
Carbon Disulfide[b]	5 - 5	26	8	2	0.2	2.4	0.5
Carbon Tetrachloide[b]	0.1 - 5	54	1.9	5	5	1.4	1.3
Chloroform[b]	0.1 - 5	53	1.9	0.2	0.2	1.2	1.2
Diethylphthalate[b]	10 - 10	8	25	4	0.6	4.3	1.5
Di-n-butylphthalate[b]	10 - 10	8	38	2	1	3.8	1.8
Methylene chloride	0.1 - 5	54	13	3	0.2	1.4	1.2
Tetrachloroethene	0.1 - 5	54	1.9	0.4	0.4	1.3	1.2
Toluene[b]	0.1 - 5	54	1.9	0.3	0.3	1.3	1.2
Trichloroethene[b]	0.1 - 5	54	1.9	0.1	0.1	1.3	1.2
Radionuclides[c] (pCi/L)							
Americium-241	0 - 0.0398	57	100	0.0906	-0.007	0.0047	0.0124
Cesium-134	1.03 - 2.49	4	100	0.6154	-0.104	0.2460	0.3792

Table 1.6 Summary of Detected Analytes in Groundwater

Analyte	Range of Reported Detection Limits	Total Number of Samples	Detection Frequency (%)	Maximum Detected Concentration	Minimum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Cesium-137	0.55 - 2.54	20	100	1.4	-0.742	0.1297	0.4672
Gross Alpha	0.4 - 7.489	55	100	32.2267	-0.51	2.5629	6.0717
Gross Beta	0.95 - 15.0478	61	100	29.6649	-0.44	3.16	5.4235
Plutonium-238	0.0027 - 0.011	5	100	0.0025	-0.0015	0.0006	0.0015
Plutonium-239/240	0 - 0.0384	57	100	0.2346	-0.0040	0.0055	0.031
Radium-226	0.049 - 0.347	10	100	3.3	0.13	1.0166	1.0478
Strontium-90	0.2 - 1.1	53	100	0.9669	-1.0894	0.1460	0.3147
Total Radiocesium	0.48 - 0.998	31	100	3.8	-0.75	0.5871	0.7064
Tritium	189.1 - 640	55	100	580	-190	104	151
Uranium-234	0 - 0.73	60	100	3.3	-0.0296	0.51	0.58
Uranium-235	0 - 0.55	60	100	0.3347	-0.027	0.071	0.085
Uranium-238	0 - 0.72	60	100	2.2	-0.018	0.371	0.447

a – For inorganics and organics the value includes ½ the detection limits for nondetects, for radionuclides all reported values are included.
b – All detections are "J" qualified, signifying that the reported result is an estimated value, below the method detection limit, but above the instrument detection limit.
c – All radionuclide values are considered detects.

Table 2.1 Essential Nutrient Screen for Surface Soil

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake (mg/day)		RDA/RDI/AI[a] (mg/day)		UL (mg/day)		Analyte Retained For PRG Screen?
Surface Soil								
Calcium	4600	0.92		1.0	500-1,200	2.0	2,500	No
Magnesium	2500	3.0	0.5	4.0	80-420	5.0	65-110	No
Potassium	2800	6.0	0.52	7.0	2,000-3,500	8.0	NA	No
Sodium	200	9.0	0.04	10.0	500-2,400	11.0	NA	No

a - RDA/RDI/AI/UL taken from NAS 2000, 2002
AI = Adequate Intake
MDC = Maximum detected concentration
PRG = Preliminary remediation goal
RDA = Recommended Dietary Allowance
RDI = Recommended Daily Intake
UL = Upper Limit Daily Intake

Table 2.2 PRG Screen for Surface Soil

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained for Detection Frequency Screen?
Inorganics (mg/kg)				
Aluminum	18000	24774	0.7	No
Antimony	0.6	44.4	0.01	No
Arsenic	**22**	**2.4**	**9.1**	**Yes**
Barium	140	2872	0.05	No
Beryllium	0.52	100	0.005	No
Boron	7.1	9477	0.0007	No
Chromium[a]	17	166630	0.0001	No
Cobalt	6.4	122	0.05	No
Copper	13	4443	0.003	No
Iron	16000	33326	0.5	No

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained for Detection Frequency Screen?
Lead	48	1000	0.048	No
Lithium	12	2222	0.005	No
Manganese	320	419	0.7	No
Mercury	0.03	33	0.0009	No
Molybdenum	0.91	555	0.002	No
Nickel	11	2222	0.005	No
Silver	0.12	555	0.0002	No
Strontium	24	66652	0.0004	No
Thallium	1.3	7.8	0.2	No
Titanium	320	169568	0.002	No
Vanadium	34	111	0.3	No
Zinc	50	33326	0.002	No
Radionuclides (pCi/g)				
Americium-241	0.0804	7.7	0.010	No
Plutonium-239/240	0.25	9.8	0.03	No
Uranium-234	1.27	25.3	0.05	No
Uranium-235	0.189	1.05	0.180	No
Uranium-238	1.7	29.3	0.06	No

a. The PRG for chromium (III) is used because chromium (III) is the predominant form of chromium in soils. The MCD is also below the PRG for chromium (VI), 28 mg/kg.

MDC = Maximum detected concentration

PRG = Preliminary remediation goal

Table 2.3 Statistical Distributions for Human Health PCOCs in Surface Soil and Sediment

Medium	Analyte	Total Samples		Statistical Distribution Testing Results					
				Background			WAEU		
		Back-ground	WAEU	Distribution/UCL Recommended by ProUCL	UCL Value (mg/kg)	Non-Detects (%)	Distribution/UCL Recommended by ProUCL	UCL Value (mg/kg)	Non-Detects (%)
Inorganics (mg/kg)									
Surface Soil	Arsenic	20	10	Normal/Student's t	6.89	0	Gamma/Gamma	11.6	0
Sediment	Arsenic	40	10	Gamma/Gamma	3.12	8	Gamma/Gamma	4.73	0
Sediment	Manganese	40	10	Gamma/Gamma	318	0	Normal/Student-t	308.6	0
Radionuclides (pCi/g)									
Sediment	Cesium-137	8	8	Non-Parametric/ Chebyshev	0.55	0	Gamma/Gamma	1.7	0
Sediment	Radium-228	13	4	Normal/Student- t	1.9	0	Normal/Student-t	4.04	0

PCOC = Potential contaminant of concern
UCL = Upper 95 percent confidence limit of the mean
WAEU = West Area Exposure Unit
ProUCL = EPA statistical software (EPA 2004)

Table 2.4 Statistical Background Comparisons for Human Health PCOCs in Surface Soil and Sediment

Medium	Analyte	Retain as PCOC?[a]			
		t-Test	WRS Test	Quantile Test	Slippage Test
Inorganics					
Surface Soil	Arsenic	NA	Yes	No	No
Sediment	Arsenic	NA	Yes	No	No
Sediment	Manganese	NA	No	No	No
Radionuclides					
Sediment	Cesium-137	NA	No	No	No
Sediment	Radium-228	Yes	NA	No	No

a. Retained by t-Test and WRS Test if p = 0.9 or more; retained by slippage test if p = 0.95 or more.
PCOC = Potential contaminant of concern
t-Test = Test for comparison of means for two sample populations with normal distributions (EPA 2002).
WRS = Wilcoxon rank sum test for comparison of medians for two sample populations with differing distributions (EPA 2002)
Quantile Test = A two sample rank test to detect a shift in the population of interest. (Johnson et al. 1987, EPA 2002)
Slippage Test = Determines if a greater number of samples than expected in the population of interest exceeds the maximum value in the background data set. (DOD 1998)
NA = Not applicable

Table 2.5 Arsenic Concentrations in WAEU and Background Surface Soil

WAEU Arsenic (mg/kg)		Background Arsenic (mg/kg)		PRG
Range	3.6 -22	Range	2.3 – 9.6	2.4
Mean	8.5	Mean	6.1	
Median	12.1	Median	5.9	
UCL	8.4	UCL	7	

WAEU = West Area Exposure Unit
PRG = Preliminary remediation goal

Table 2.6 PRG Screen for Sediment

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained for Detection Frequency Screen?
Inorganics (mg/kg)				
Aluminum	19400	24774	0.8	No
Antimony	12.4	44.4	0.3	No
Arsenic	**5.3**	**2.4**	**2.20**	**Yes**
Barium	244	2872	0.09	No
Beryllium	1.4	100	0.014	No
Cadmium	1.3	91.4	0.01	No
Chromium	24.8	166630	0.00001	No
Cobalt	10.1	122	0.08	No
Copper	25.9	4443	0.006	No
Iron	23400	33326	0.70	No
Lead	25.5	1000	0.03	No
Lithium	20.3	2222	0.01	No
Manganese	**470**	**419**	**1.06**	**Yes**
Molybdenum	2.4	555	0.004	No
Nickel	17.6	22224	0.008	No
Nitrate/Nitrite	76	177739	0.0004	No
Silver	2	555	0.004	No
Strontium	41.2	66652	0.0006	No
Thallium	0.4	7.8	0.05	No
Tin	17.5	66652	0.0003	No
Vanadium	51.9	111	0.47	No
Zinc	720	33326	0.02	No
Organics (ug/kg)				
2-Butanone	3	46373332	0.0000001	No
4-Methylphenol	95	400718	0.0002	No
Benzoic Acid	480	320574148	0.000001	No

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained for Detection Frequency Screen?
bis(2-Ethylhexyl)phthalate	250	213750	0.001	No
Di-n-butylphthalate	150	8014354	0.00002	No
Fluoranthene	88	2958512	0.00003	No
Pyrene	61	2218884	0.00003	No
Toluene	2	3094217	0.000001	No
Radionuclides (pCi/g)				
Americium-241	0.087	7.7	0.011	No
Cesium-137	**1.498**	**0.22**	**6.78**	**Yes**
Plutonium-239/240	0.040	9.8	0.004	No
Radium-226	1.800	2.7	0.668	No
Radium-228	**4.1**	**0.11**	**36.9**	**Yes**
Strontium-90	0.319	13.2	0.024	No
Tritium	0.440	25082	.00002	No
Uranium-234	3.079	25.3	0.122	No
Uranium-235	0.14	1.05	0.133	No
Uranium-238	2.81	29.3	0.096	No

MDC = Maximum detected concentration
PRG = Preliminary remediation goal

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Table 2.7 PRG Screen for Subsurface Soil < 8 ft

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained for Detection Frequency Screen?
Inorganics (mg/kg)				
Aluminum	15400	284902	0.054	No
Arsenic	3.6	27.7	0.13	No
Barium	64	33033	0.002	No
Beryllium	1.2	1151	0.001	No
Chromium	13.6	1916250	0.00001	No
Cobalt	7.9	1401	0.006	No
Copper	11	51100	0.0002	No
Iron	18100	383250	0.047	No
Lead	5.7	1000	0.006	No
Lithium	7.5	25550	0.0003	No
Manganese	295	4815	0.061	No
Nickel	12.6	25550	0.0005	No
Strontium	45	766500	0.0001	No
Tin	33.9	766500	0.00004	No
Vanadium	36.1	1278	0.028	No
Zinc	26.9	383250	0.0001	No

MDC = Maximum detected concentration
PRG = Preliminary remediation goal

Table 2.8 Anion/Cation Screen for Surface Water

Analyte	Is Analyte an Anion/Cation?	Analyte Retained for Further Screening?
Orthophosphate	Yes	No
Sulfate	Yes	No

Table 2.9 Essential Nutrient Screen for Surface Water

Analyte	MDC (mg/L)	Maximum Daily Intake (mg/day)	RDA/RDI/AI (mg/day)	Upper Limit Daily Intake (mg/day)	Analyte Retained For PRG Screen?
Calcium	39.2	1.96	500-1,200	2,500	No
Magnesium	18.2	0.91	80-420	65-110	No
Potassium	15.4	0.77	2,000-3,500	NA	No
Sodium	33.4	1.67	500-2,400	NA	No

RDA/RDI/AI/UL taken from NAS 2000, 2002
AI = Adequate Intake
MDC = Maximum detected concentration
ND = Not detected
PRG = Preliminary remediation goal
RDA = Recommended Dietary Allowance
RDI = Recommended Daily Intake
UL = Upper Intake Level

Table 2.10 PRG Screen for Surface Water

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained For Detection Frequency Screen?
Inorganics (mg/L)				
Aluminum	129	2028	0.06	No
Antimony	0.029	0.8	0.04	No
Arsenic	0.0167	0.05	0.33	No
Barium	0.63	142	0.004	No
Beryllium	0.0037	4.1	0.0009	No
Cadmium	0.0038	1.0	0.004	No
Chromium	0.247	3042	0.00008	No
Cobalt	0.0193	40.6	0.0005	No
Copper	0.0484	81.1	0.0006	No
Cyanide	0.0024	40.6	0.00006	No

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained For Detection Frequency Screen?
Fluoride	1	122	0.008	No
Iron	88.6	608	0.15	No
Lithium	0.154	40.6	0.004	No
Manganese	0.492	284	0.002	No
Mercury	0.00477	0.61	0.078	No
Molybdenum	0.0084	10.1	0.0008	No
Nickel	0.12	40.6	0.003	No
Nitrate/Nitrite	2	3244	0.0006	No
Nitrite	0.058	203	0.0003	No
Selenium	0.019	10.1	0.002	No
Silver	0.0028	10.1	0.0003	No
Strontium	0.238	1217	0.0002	No
Thallium	0.007	0.1	0.05	No
Tin	0.0042	1217	0.000003	No
Uranium, total	0.0038	6.1	0.0006	No
Vanadium	0.132	2.0	0.07	No
Zinc	0.103	608	0.0002	No
Organics (ug/L)				
2-Butanone	3	1216667	0.000002	No
Acetone	28	1825000	0.00001	No
Methylene chloride	16	10121	0.001	No
Oil And Grease	17800	NA	NC	No
Radionuclides (pCi/L)				
Americium-241	0.024	408	0.00005	No
Cesium-137	0.5	1396	0.0002	No
Plutonium-238	0.01343	324	0.00004	No
Plutonium-239/240	0.043	314	0.0004	No
Radium-226	4.9	110	0.045	No
Strontium-90	2.172	574.000	0.004	No
Tritium	751	837105	0.0009	No
Uranium-234	5.1	600	0.009	No

Analyte	MDC	PRG	Ratio MDC/PRG	Analyte Retained For Detection Frequency Screen?
Uranium-235	0.29	610	0.0005	No
Uranium-238	4.9	663	0.007	No

Site background mean for total lead + 2 standard deviations
MDC = Maximum detected concentration
PRG = Preliminary remediation goal
NA – Not available
NC – Not calculated

Table 2.11 Volatilization Screen for Subsurface Soil

Chemical Name	MDC (ug/l)	Groundwater Volatilization PRG (ug/L)	MDC/ PRG Ratio	Retain as COC?
1,1,2,2-Tetrachloroethane	1	907	0.001	No
1,1,2-Trichloroethane	0.7	824	0.0008	No
4-Methyl-2-pentanone	3	6420000	0.0000004	No
Bromoform	0.6	25400	0.00002	No
Carbon Disulfide	2	18300	0.0001	No
Carbon Tetrachloride	5	62	0.08	No
Chloroform	0.2	146	0.001	No
Methylene chloride	3	10000	0.0003	No
Tetrachloroethene	0.4	21400	0.00002	No
Toluene	0.3	28200	0.00001	No
Trichloroethene	0.1	1830	0.00006	No

MDC = Maximum detected concentration
PRG = Preliminary remediation goal

Table 2.12 Summary of the COC Selection Process

Analyte	PRG Ratio	Detection Frequency (%)	Concentration > 30X the PRG?	Background Comparison	Professional Judgment	COC?
Surface Soil						
Arsenic	9.1	100	NA	Retain	Eliminate	No
Sediments						
Arsenic	2.2	92	NA	Retain	Eliminate	No
Manganese	1.1	100	NA	Retain	Eliminate	No
Cesium-137	6.8	100	NA	Retain	Eliminate	No
Radium-228	36.9	100	NA	Retain	Eliminate	No
Subsurface Soil						
None >PRG						
Surface Water						
None >PRG						
Groundwater						
None >PRG						

COC = Contaminant of concern
PRG = Preliminary remediation goal
NA = Not applicable

Table 7.1 Comparison of Maximum Detected Concentrations in Surface Soil with NOAEL ESLs for the PMJM

Analyte	MDC (mg/kg)	PMJM NOAEL ESL	MDC > ESL?	Retained for Background Analysis?
Aluminum	18000	NA	NA	UC
Antimony	0.6	1.00	No	No
Arsenic	**22**	**2.21**	**Yes**	**Yes**
Barium	140	743	No	No
Beryllium	0.52	8.16	No	No
Boron	7.1	52.7	No	No
Chromium	17	16079	No	No
Cobalt	6.4	340	No	No
Copper	13	95	No	No
Iron	16000	NA	NA	UC
Lead	48	220	No	No
Lithium	12	519	No	No
Manganese	320	388	No	No
Mercury	0.03	0.05	No	No
Molybdenum	0.91	1.84	No	No
Nickel	**11**	**0.51**	**Yes**	**Yes**
Silver	0.12	NA	NA	UC
Strontium	24	833	No	No
Thallium	1.3	8.64	No	No
Titanium	320	NA	NA	UC
Vanadium	**34**	**21.60**	**Yes**	**Yes**
Zinc	**50**	**6.41**	**Yes**	**Yes**

MDC = maximum detected concentration

UC = Uncertainty toxicity; no ESLs available. Will be discussed in uncertainty section.NA indicates that no ESL was available for that ECOI/Receptor pair.

NA indicates that no ESL was available for that ECOI/Receptor pair.

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Table 7.2 Statistical Distributions for PMJM ECOIs in Surface Soils

Analyte	Total Samples		Statistical Distribution Testing Results					
			Background			WEAU		
	Background	WAEU	Distribution/UCL Recommended by ProUCL	UCL Value (mg/kg)	Non-detects (%)	Distribution/UCL Recommended by ProUCL	UCL Value (mg/kg)	Non-detects (%)
Arsenic	20	10	Normal/Student's *t*	6.89	0	Gamma/Gamma	11.63	0
Nickel	20	10	Normal/Student's *t*	10.7	0	Normal/Student's *t*	9.73	0
Vanadium	20	10	Normal/Student's *t*	31.2	0	Normal/Student's *t*	30.9	0
Zinc	20	10	Normal/Student's *t*	54.5	0	Normal/Student's *t*	42.2	0

WAEU = West area exposure unit

UCL = The 95 percent upper confidence limit of the mean.

NA =Not available

The results of the WRS test indicate that arsenic concentrations in surface soil in the WAEU are greater than those in background surface soil; however, as discussed below, elevated arsenic concentrations in the WAEU do not appear to be a result of historical waste disposal or other operations at RFETS.

Various metals were used in weapons production, and site records indicate inventories for the metals used at RFETS (see Table x). Lead had the largest inventory as a gamma shielding material on Site. Beryllium and aluminum also had a relatively high inventory because they were used in the fabrication of some weapon components. Other metals had much smaller inventories, and arsenic had one of the lowest inventories. Consequently, arsenic is not expected to be present in significant quantities in waste disposed at RFETS. Furthermore, there are no known waste disposal sites in the WAEU.

TABLE x – METAL INVENTORIES AT THE ROCKY FLATS PLANT

*METAL	INVENTORY (KG)*
Lead	140-504000
Beryllium	1-9140
Aluminum	1470 - 7700
Manganese	6-2580
Zinc	87-1610
Chromium	96 -730
Cobalt	12-700
Mercury	9-446
Nickel	120-194
Cadmium	43-100
Copper	22 - 84
Barium	30 - 37
Molybdenum	13-27
Silver	18-26
Vanadium	4-13
Antimony	3 - 8
Strontium	4 - 7
Arsenic	4 - 5
Selenium	<1 - 1
Thallium	<1 - <1

*Values are approximate totals from the 1974 and 1988 plant inventories (DOE 1991).

Arsenic occurs in soil at significantly elevated concentrations relative to background (e.g., > 200 mg/kg) at only two locations at RFETS; PAC 700-137 (Cooling Tower Blowdown Buildings 712 and 713) (DOE 1995), and PAC SE 1602 (East Firing Range) (DOE 2004). In both locations, the source of the arsenic does not appear to be from waste disposal. The arsenic may be present in the soil at the cooling tower (PAC 700-137) because chromated copper arsenate was typically used as a wood preservative for lumber designed for outdoor use, and cooling towers had wooden slats. It may also be present in the soil due to the historical use of organic arsenical pesticides and herbicides at RFETS (DOE 1991). At the east firing range (PAC SE-1602), arsenic is present in the soil because of the presence of bullet fragments, and arsenic is a component of the bullets (DOE 2004). Even with these two arsenic sources, arsenic was not identified as a Contaminant of Concern in soil or sediment for the human health risk assessments performed for the Walnut Creek Priority Drainage (DOE 1996a) and the Woman Creek Priority Drainage (DOE 1996b) Portions of these drainages are topographically downgradient of these two PACs.

The WAEU is located topographically upgradient from the two aforementioned arsenic sources at RFETS, and is also predominantly upwind. Transport of arsenic to the WAEU by runoff is not possible, and by wind is remote. The nearest area that has been impacted by operations at RFETS is the West Spray Field. Arsenic is not associated with past spray activities in this area (DOE 1995c). The arsenic levels in surface soil in the spray field area were also slightly above background, but investigations clearly showed that there was no correlation of concentration levels with past disposal activities in the area and arsenic was not evaluated as a COC for this area (DOE 1995c).

The apparently higher arsenic concentrations in the WAEU are likely due to spatial variations of naturally occurring arsenic in alluvial materials. It does not appear to be derived from waste disposal or other operations at RFETS. Therefore, arsenic in surface soil in the WAEU is not considered a COC and is not further evaluated in this human health risk assessment.

DOE, 1991, Identification of Chemicals and Radionuclides Used at Rocky Flats; Toxicological Review and Dose Reconstruction Project Task 1 Report, CDPHE, March 1991.

DOE, 1995, Draft Data Summary 2 Operable Unit No. 8 700 Area Environmental Restoration Program.

DOE, 1996a, Final Phase I RFI/RI Report, Walnut Creek Priority Drainage, Operable Unit No. 6, Rocky Flats Environmental Technology Site, Golden, Colorado, February.

DOE, 1996b, Final Phase I RFI/RI Report, Woman Creek Priority Drainage Operable Unit No. 5, Rocky Flats Environmental Technology Site, Golden, Colorado, April.

DOE, 2004, Closeout Report for IHSS Group 900-11, PAC SE-1602, East Firing Range and Target Area, December.

Table 7.3 Satistical Comparison for PMJM ECOIs in Surface Soil

Medium	Analyte	Retained PCOC?			
		t-Test	WRS Test	Quantile Test	Slippage Test
Inorganics					
Surface Soil	Arsenic	NA	Yes	No	No
	Nickel	No	NA	Yes	No
	Vanadium	No	NA	No	No
	Zinc	No	NA	No	No

a. Retained by t-Test and WRS Test if p = 0.9 or more; retained by slippage test if p = 0.95 or more.

PCOC = Potential contaminant of concern
t-Test = Test for comparison of means for two sample populations with normal distributions (EPA 2002).

WRS = Wilcoxon rank sum test for comparison of medians for two sample populations with differing distributions (EPA 2002)

Quantile Test = A two sample rank test to detect a shift in the population of interest. (Johnson et al. 1987, EPA 2002)

Slippage Test = Determines if a greater number of samples than expected in the population of interest exceeds the maximum value in the background data set. (DOD 1998)

NA = Not applicable

Table 7.4 Comparison of Maximum Detected Concentrations in Surface Soil to NOAEL ESLs for Terrestrial Vertebrates

Analyte	MDC	Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor		Most Sensitive Receptor	Retain For Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Inorganics (mg/kg)																									
Aluminum	18000	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	UC
Antimony	0.6	NA	No	NA	No	NA	No	9.89	No	0.90	No	18.72	No	57.62	No	137.93	No	13.18	No	3.85	No	NA	NA	Deer Mouse Insectivore	No
Arsenic	22	20	**Yes**	164	No	1028	No	2.57	**Yes**	51.36	No	9.35	**Yes**	12.99	**Yes**	709	No	341	No	293	No	NA	NA	Deer Mouse Herbivore	***Yes***
Barium	140	159	No	357	No	1317	No	930	No	4427	No	3224	No	4766	No	24896	No	19838	No	18369	No	NA	NA	Dove Herbivore	No
Beryllium	0.52	NA	No	NA	No	NA	No	159.76	No	6.82	No	210.86	No	895.62	No	1071.87	No	102.77	No	29.19	No	NA	NA	Deer Mouse Insectivore	No
Boron	7.1	30.29	No	114.56	No	167.49	No	62.12	No	422.32	No	236.82	No	313.67	No	929.47	No	6070.46	No	1816	No	NA	NA	Dove Herbivore	No
Chromium	17	24.56	No	1.34	**Yes**	13.96	**Yes**	237093	No	13233	No	586207	No	1231773	No	5735367	No	219264	No	57200	No	NA	NA	Dove Insectivore	***Yes***
Cobalt	6.4	278	No	87.03	No	440	No	1476	No	363	No	2461	No	7902	No	3785	No	2492	No	1519	No	NA	NA	Dove Insectivore	No
Copper	13	28.86	No	8.25	**Yes**	164.50	No	294.68	No	605.46	No	837.57	No	4118.52	No	5459.33	No	3000.41	No	4641	No	NA	NA	Dove Insectivore	***Yes***
Iron	16000	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	NA	NA	UC
Lead	48	49.94	No	12.06	**Yes**	95.83	No	1344	No	242	No	1850	No	9798	No	8927	No	3065.78	No	1393	No	NA	NA	Dove Insectivore	***Yes***
Lithium	12	NA	No	NA	No	NA	No	1882	No	610	No	3178	No	10173	No	18431	No	5607.76	No	2560	No	NA	NA	Deer Mouse Insectivore	No
Manganese	320	1032	No	2631	No	9917	No	486	No	4080	No	221	**Yes**	2506	No	14051	No	10939.26	No	19115	No	NA	NA	Prairie Dog	***Yes***
Mercury	0.03	0.20	No	0.0001	**Yes**	1.57	No	0.44	No	0.18	No	3.15	No	7.56	No	8.18	No	8.49	No	37.27	No	NA	NA	Dove Insectivore	***Yes***
Molybdenum	0.91	44.37	No	6.97	No	76.70	No	8.68	No	1.90	No	27.14	No	44.26	No	275.13	No	28.95	No	8.18	No	NA	NA	Deer Mouse Insectivore	No
Nickel	11	44.14	No	1.24	**Yes**	13.09	No	16.39	No	0.43	**Yes**	38.35	No	123.85	No	90.87	No	6.02	**Yes**	1.86	**Yes**	NA	NA	Deer Mouse Insectivore	***Yes***
Selenium	NA	1.61	No	1.00	No	8.48	No	0.87	No	0.75	No	2.80	No	3.82	No	32.49	No	12.21	No	5.39	No	NA	NA	Deer Mouse Insectivore	No
Silver	0.12	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	NA	NA	UC
Strontium	24	NA	No	NA	No	NA	No	940	No	13578	No	3519	No	4702.	No	584444	No	144904	No	57298	No	NA	NA	Deer Mouse Herbivore	No
Thallium	1.3	NA	No	NA	No	NA	No	180.18	No	7.24	No	204.34	No	1038.96	No	211.92	No	81.58	No	30.82	No	NA	NA	Deer Mouse Insectivore	No
Tin	NA	26.06	No	2.90	No	18.98	No	45.05	No	3.77	No	80.57	No	241.78	No	70.03	No	36.07	No	16.21	No	NA	NA	Dove Insectivore	No
Titanium	320	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	NA	NA	UC
Vanadium	34	503	No	274	No	1514	No	63.70	No	29.91	**Yes**	83.52	No	358	No	341	No	164	No	121	No	NA	NA	Deer Mouse Insectivore	***Yes***
Zinc	50	108.73	No	0.65	**Yes**	113	No	171	No	5.29	**Yes**	1174	No	2772	No	16489	No	3887	No	431	No	NA	NA	Dove Insectivore	***Yes***
Radionuclide (pCi/g)																									
Americium-241	0.080	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3890.00	No	NA	No
Plutonium-239/240	0.250	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6110.00	No	NA	No
Uranium-234	1.270	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4980.00	No	NA	No
Uranium-235	0.189	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2770.00	No	NA	No
Uranium-238	1.700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1580.00	No	NA	No

NA indicates that no ESL was available for that ECOI/Receptor pair.
UC = Uncertainty toxicity; no ESL available. Will be discussed in uncertainty section.

Table 7.5 Comparison of Maximum Detected Concentrations in Surface Soil to Terrestrial Plant and Invertebrate ESLs

Receptor	Analyte	ESL	MDC > ESL?	MDC > ESL?
Terrestrial Invertebrates	Aluminum	NA	18000	UC
	Antimony	78	0.6	No
	Arsenic	60	22	No
	Barium	330	140	No
	Beryllium	40	0.83	No
	Boron	NA	7.1	UC
	Chromium	**0.4**	**17**	**Yes**
	Cobalt	NA	6.4	No
	Copper	50	13	No
	Iron	NA	16000	UC
	Lead	1700	48	No
	Lithium	NA	12	UC
	Manganese	NA	320	UC
	Mercury	0.1	0.03	No
	Molybdenum	NA	0.91	UC
	Nickel	200	11	No
	Silver	NA	0.4	UC
	Strontium	NA	24	UC
	Thallium	NA	1.3	UC
	Titanium	NA	320	UC
	Vanadium	NA	34	UC
	Zinc	200	50	No
Terrestrial Plants	**Aluminum**	**50**	**18000**	**Yes**
	Antimony	5	0.6	No
	Arsenic	**10**	**22**	**Yes**
	Barium	500	140	No
	Beryllium	10	0.83	No
	Boron	**0.5**	**7.1**	**Yes**
	Chromium	**1**	**17**	**Yes**
	Cobalt	13	6.4	No
	Copper	100	13	No
	Iron	NA	16000	UC
	Lead	110	48	No
	Lithium	**2**	**12**	**Yes**
	Manganese	500	320	No
	Mercury	0.3	0.03	No
	Molybdenum	2	0.91	No
	Nickel	30	11	No
	Silver	2	0.12	No
	Strontium	NA	24	UC
	Thallium	**1**	**1.3**	**Yes**
	Titanium	NA	320	UC
	Vanadium	**2**	**34**	**Yes**
	Zinc	50	50	No

UC = Uncertainty toxicity; no ESL available. Will be discussed in uncertainty section.

Table 7.6 Summary of NOAEL ESL Screening Results for Surface Soil in the WAEU

Analyte	Terrestrial Vertebrate Exceedance?	Terrestrial Invertebrate Exceedance?	Terrestrial Plant Exceedance?
Aluminum	UC	UC	**Yes**
Antimony	No	No	No
Arsenic	**Yes**	No	**Yes**
Barium	No	No	No
Beryllium	No	No	No
Boron	No	UC	**Yes**
Chromium	**Yes**	**Yes**	**Yes**
Cobalt	No	UC	No
Copper	**Yes**	No	No
Iron	UC	UC	UC
Lead	**Yes**	No	No
Lithium	No	UC	**Yes**
Manganese	**Yes**	UC	No
Mercury	**Yes**	No	No
Molybdenum	No	UC	No
Nickel	**Yes**	No	No
Silver	UC	UC	No
Strontium	No	UC	UC
Thallium	No	UC	**Yes**
Titanium	UC	UC	UC
Vanadium	**Yes**	UC	**Yes**
Zinc	**Yes**	No	No

UC = UC = Uncertainty toxicity; no ESL available. Will be discussed in uncertainty section.

Table 7.7 Statistical Distributions for Non-PMJM ECOIs in Surface Soils

Analyte	Total Samples		Statistical Distribution Testing Results					
			Background			WEAU		
	Background	WAEU	Distribution/UCL Recommended by ProUCL	UCL Value (mg/kg)	Non-detects (%)	Distribution/UCL Recommended by ProUCL	UCL Value (mg/kg)	Non-detects (%)
Aluminum	20	10	Normal/Student's *t*	11,716	0	Normal/Student's *t*	15,357	0
Arsenic	20	10	Normal/Student's *t*	6.89	0	Gamma/Gamma	11.63	0
Boron	0	10	NA	NA	NA	Normal/Student's *t*	5.8	0
Chromium	20	10	Normal/Student's *t*	12.6	0	Normal/Student's *t*	14.84	0
Copper	20	10	Normal/Student's *t*	14.0	0	Normal/Student's *t*	11.0	0
Lead	20	10	Normal/Student's *t*	37.7	0	Normal/Student's *t*	37.07	0
Lithium	20	10	Normal/Student's *t*	8.54	0	Normal/Student's *t*	10.3	0
Manganese	20	10	Normal/Student's *t*	264	0	Normal/Student's *t*	292	0
Mercury	20	10	Normal/Student's *t*	0.084	60	Normal/Student's *t*	0.027	0
Nickel	20	10	Normal/Student's *t*	10.7	0	Normal/Student's *t*	9.73	0
Thallium	16	10	Normal/Student's *t*	0.421	100	Nonparametric/Student's *t*	0.72	90
Vanadium	20	10	Normal/Student's *t*	31.2	0	Normal/Student's *t*	30.9	0
Zinc	20	10	Normal/Student's *t*	54.5	0	Normal/Student's *t*	42.2	0

WAEU = West area exposure unit
UCL = The 95 percent upper confidence limit of the mean.
NA =Not available

Table 7.8 Satistical Comparison for Non-PMJM ECOIs in Surface Soil

Medium	Analyte	Retained as ECOI?			
		t-Test	WRS Test	Quantile Test	Slippage Test
	Aluminum	Yes	NA	No	No
Surface Soil	Arsenic	NA	Yes	No	No
	Boron	NA	NA	NA	NA
	Chromium	Yes	NA	No	No
	Copper	NA	No	Yes	No
	Lead	No	NA	No	No
	Lithium	Yes	NA	No	No
	Manganese	No	NA	Yes	No
	Mercury	NA	No	No	No
	Nickel	No	NA	Yes	No
	Thallium	NA	NA	NA	NA
	Vanadium	No	NA	No	No
	Zinc	No	NA	No	No

a. Retained by t-Test and WRS Test if p = 0.9 or more; retained by slippage test if p = 0.95 or more.

ECOI = Ecological contaminant of interest

t-Test = Test for comparison of means for two sample populations with normal distributions (EPA 2002).

WRS = Wilcoxon rank sum test for comparison of medians for two sample populations with differing distributions (EPA 2002)

Quantile Test = A two sample rank test to detect a shift in the population of interest. (Johnson et al. 1987, EPA 2002)

Slippage Test = Determines if a greater number of samples than expected in the population of interest exceeds the maximum value in the background data set. (DOD 1998)

NA = Not applicable

Table 7.9 Comparison of Thallium Surface Soil Data for WAEU and Background

Thallium			
WAEU Surface Soils (mg/kg)		Background Surface Soils (mg/kg)*	
0.48		0.385	0.42
0.48		0.4	0.420
0.485		0.405	0.425
0.485		0.405	0.425
0.49		0.405	0.43
0.495		0.41	0.445
0.495		0.410	
0.5		0.41425	
0.5		0.415	
1.3		0.415	
Range	0.48 - 1.3	0.385 - 0.445	
Mean	0.571	0.414	
Median	0.4925	0.415	
95th UCL	0.719	0.421	

*All values for nondetects are 1/2 the reported result; only one value is

Table 7.10

Comparison of Maximum Detected Concentrations in WAEU Subsurface Soil to NOAEL ESLs for the Burrowing Receptor

Analyte	MDC	Preliminary NOAEL ESL (mg/kg)	MDC >ESL?
Aluminum	15400	NA	UC
Arsenic	3.6	9.35	No
Barium	64	3220	No
Beryllium	1.2	211	No
Chromium	13.6	586000	No
Cobalt	7.9	2461	No
Copper	11	838	No
Iron	18100	NA	UC
Lead	5.7	1850	No
Lithium	7.5	3180	No
Manganese	**295**	**221**	**Yes**
Nickel	12.6	38.3	No
Strontium	45	3519	No
Tin	33.9	80.6	No
Vanadium	36.1	83.5	No
Zinc	26.9	1170	No

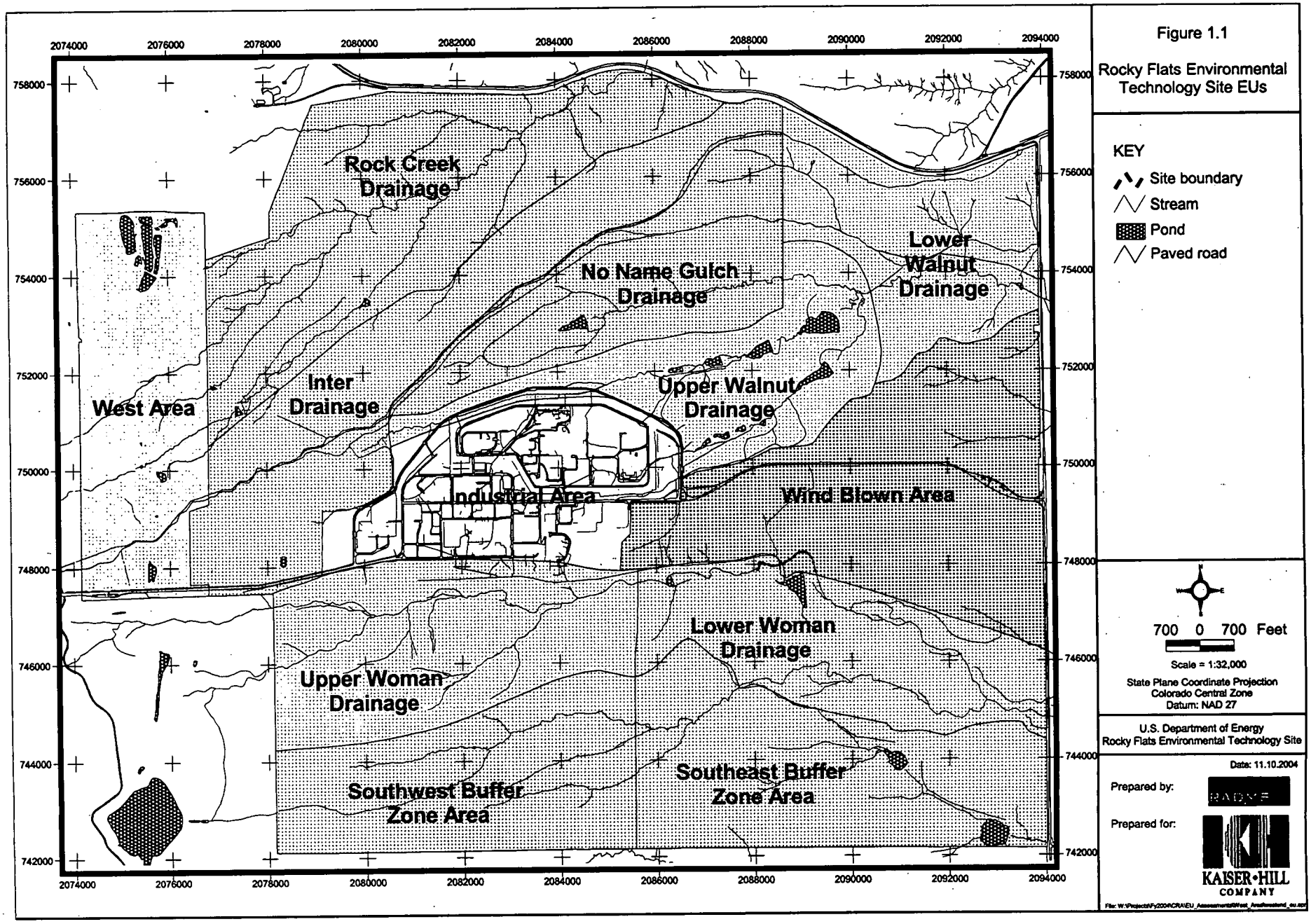
NA = Not Available

UC = Uncertainty toxicity; no ESLs available. Will be discussed in uncertainty section.

Table 11.1 ECOIs without Toxicity Data

	Has Toxicity Data?				
Analyte	PMJM	Terrestrial Invertebrates	Mammals	Birds	Terrestrial Plants
Aluminum	No	No	No	No	Yes
Antimony	Yes	Yes	Yes	No	Yes
Beryllium	Yes	Yes	Yes	No	Yes
Boron	Yes	No	Yes	Yes	Yes
Cobalt	Yes	No	Yes	Yes	Yes
Iron	No	No	No	No	No
Lithium	Yes	No	Yes	No	No
Manganese	Yes	No	Yes	Yes	Yes
Silver	No	No	No	No	Yes
Strontium	Yes	No	Yes	No	No
Thallium	Yes	No	Yes	No	Yes
Titanium	No	No	No	No	No
Vanadium	Yes	No	Yes	Yes	Yes

PMJM = Preble's meadow jumping mouse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752000
750000
748000
746000
744000
742000
Rock Creek Drainage
No Name Gulch Drainage
Lower Walnut Drainage
West Area
Inter Drainage
Upper Walnut Drainage
Industrial Area
Wind Blown Area
Lower Woman Drainage
Upper Woman Drainage
Southwest Buffer Zone Area
Southeast Buffer Zone Area
Figure 1.1
Rocky Flats Environmental Technology Site EUs
KEY
Site boundary
Stream
Pond
Paved road
700 0 700 Feet
Scale = 1:32,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
Date: 11.10.2004
Prepared by:
Prepared for:
KAISER•HILL COMPANY

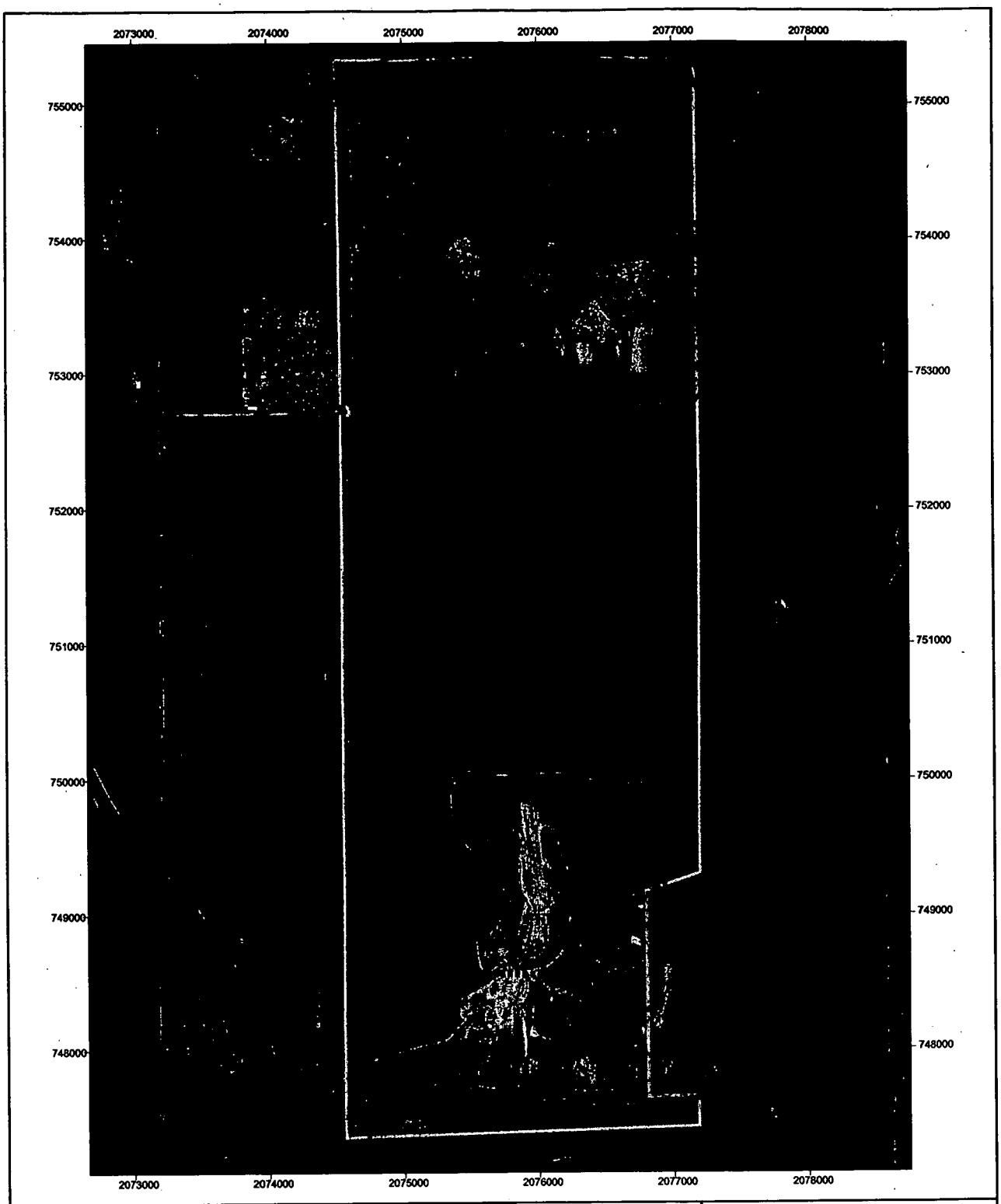

Figure 1.2

Aerial Photograph of West Area Exposure Unit July 2004

DRAFT

KEY

Exposure unit

West Area

July 2004 Soil Disturbance Area

Stream

ephemeral
intermittent
perennial

500 0 500 Feet

Scale 1:12,500

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: RADMS

Date:September 2004

Prepared for: KAISER•HILL COMPANY

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77

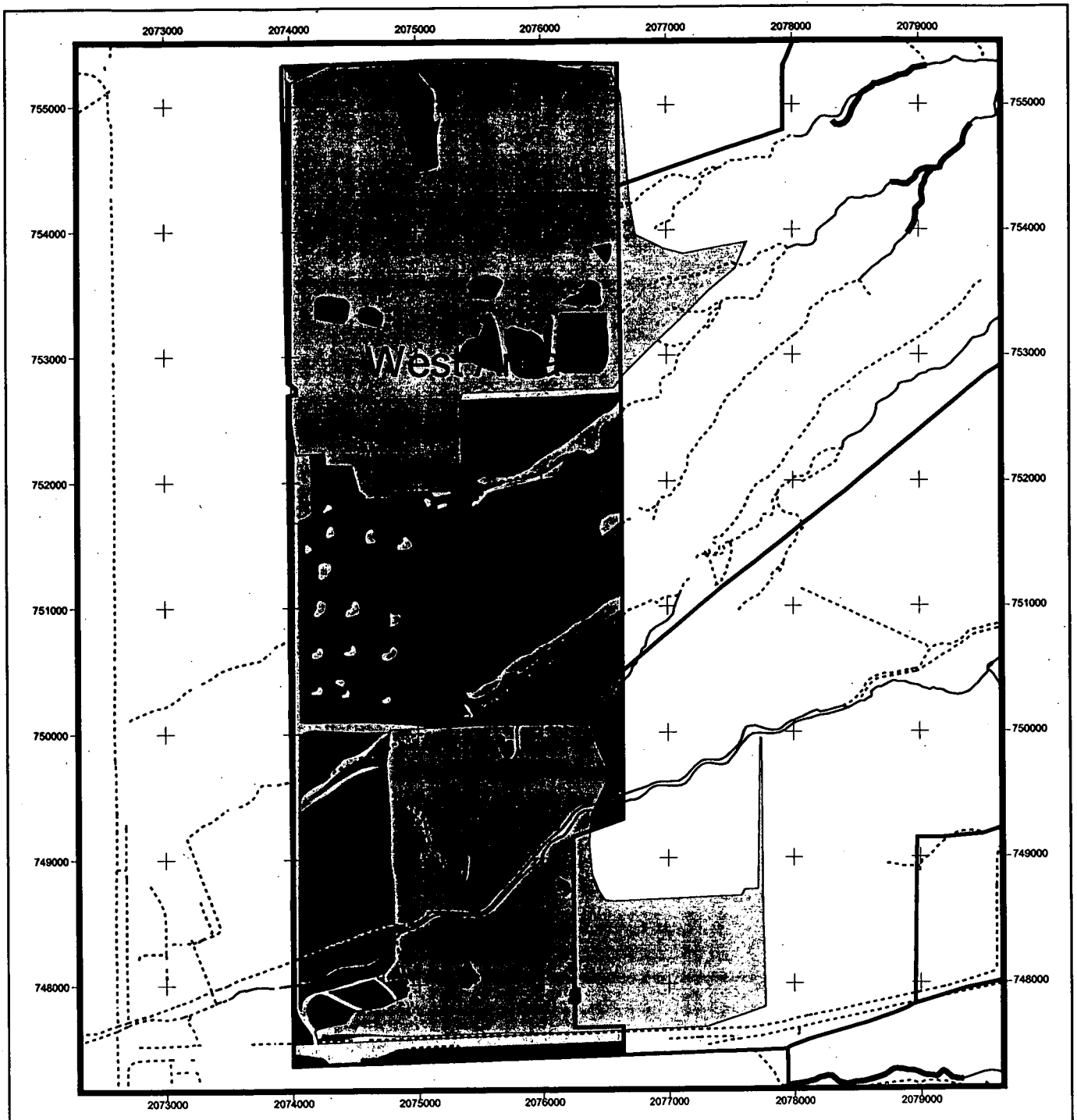

Figure 1.3

Vegetation in the West Area Exposure Unit

DRAFT

KEY

- Exposure Unit
- Open water, July 2004
- Soil Disturbance Area, July 2004

Vegetation, 1996

- Annual Grass/Forb Community
- Disturbed and Developed Areas
- Leadplant Riparian Shrubland
- Mesic Mixed Grassland
- Open Water
- Ponderosa Woodland
- Reclaimed Mixed Grassland
- Short Marsh
- Short Upland Shrubland
- Tall Marsh
- Tall Upland Shrubland
- Wet Meadow/Marsh Ecotone
- Xeric Tallgrass Prairie

- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

500 0 500 Feet

Scale 1: 13,500

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 12.15.2004

Prepared by: RADMS

Prepared for: KAISER•HILL COMPANY

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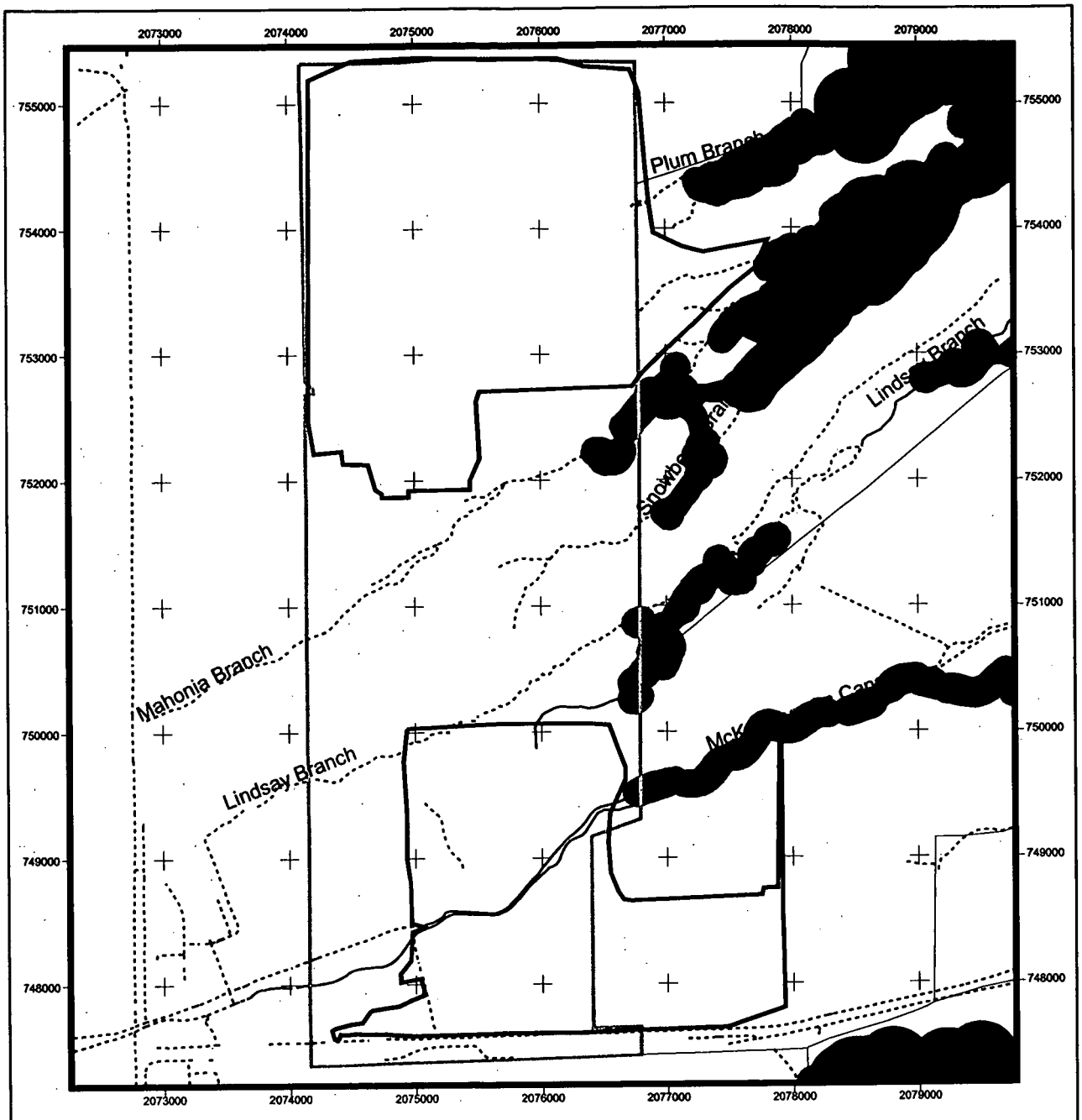

1.4

Prebles Meadow Jumping Mouse Habitat in the West Area EU

DRAFT

KEY

- PMJM Habitat
- July 2004 Soil Disturbance Area
- West Area EU
- Exposure unit

Stream

- Perennial
- Intermittent
- Ephemeral

N W E S

500 0 500 Feet

Scale 1:14,500

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 12.15.2004

Prepared by: RADMS

Prepared for: KAISER•HILL COMPANY

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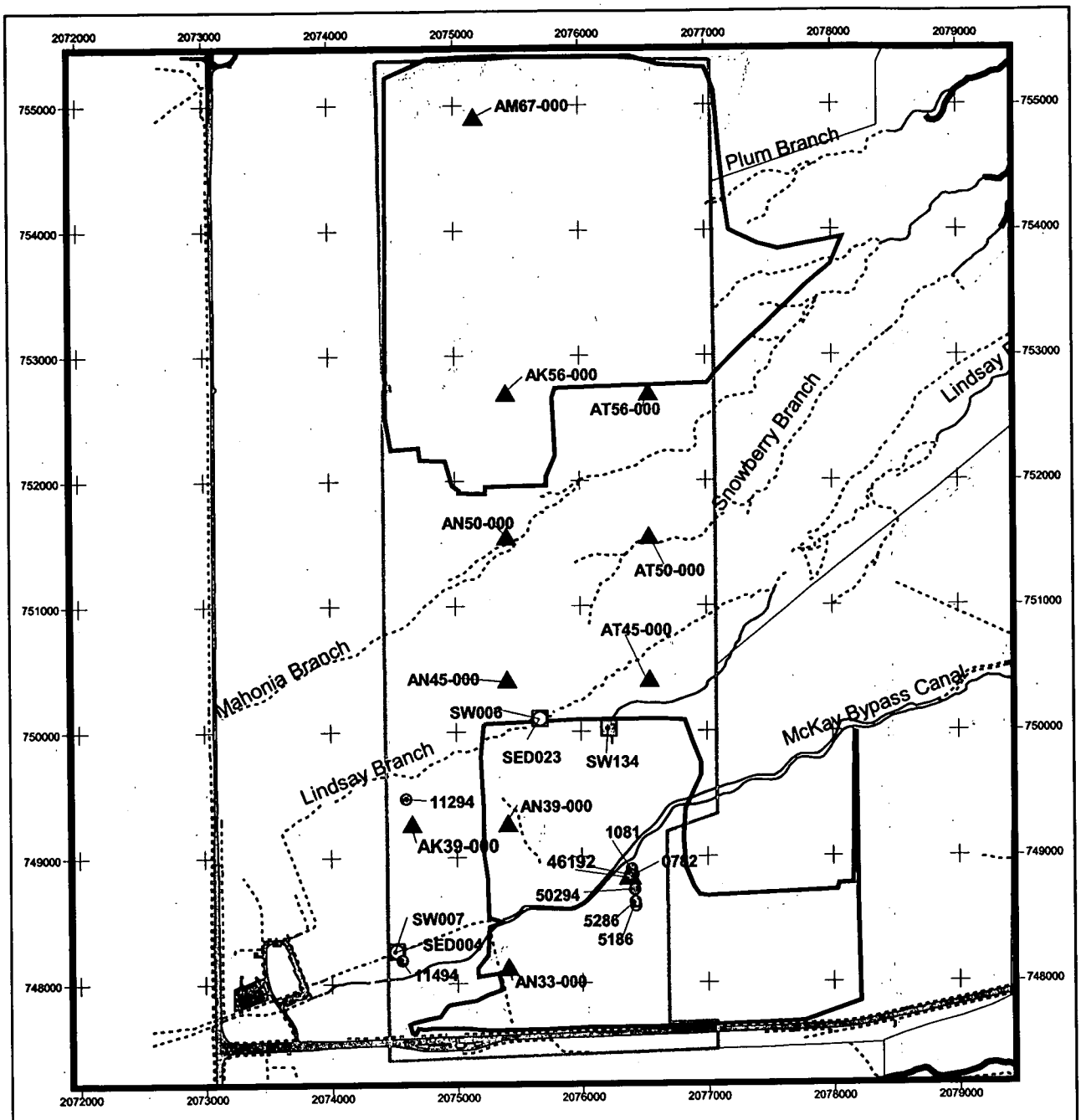

Figure 1.5

West Area EU
Sampling Location

DRAFT

KEY

- Groundwater sampling location
- Sediment sampling location
- Surface water sampling location
- Subsoil sampling location
- Surface soil sampling location
- July 2004 Soil Disturbance Area
- West Area EU
- Exposure unit
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Dirt road
- Paved road

N
W E
S

500 0 500 Feet

Scale 1:14,500

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 12.15.04

Prepared by: RADMS

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\CRA\EU_Assessments\West_Area\westeond_eu.apr

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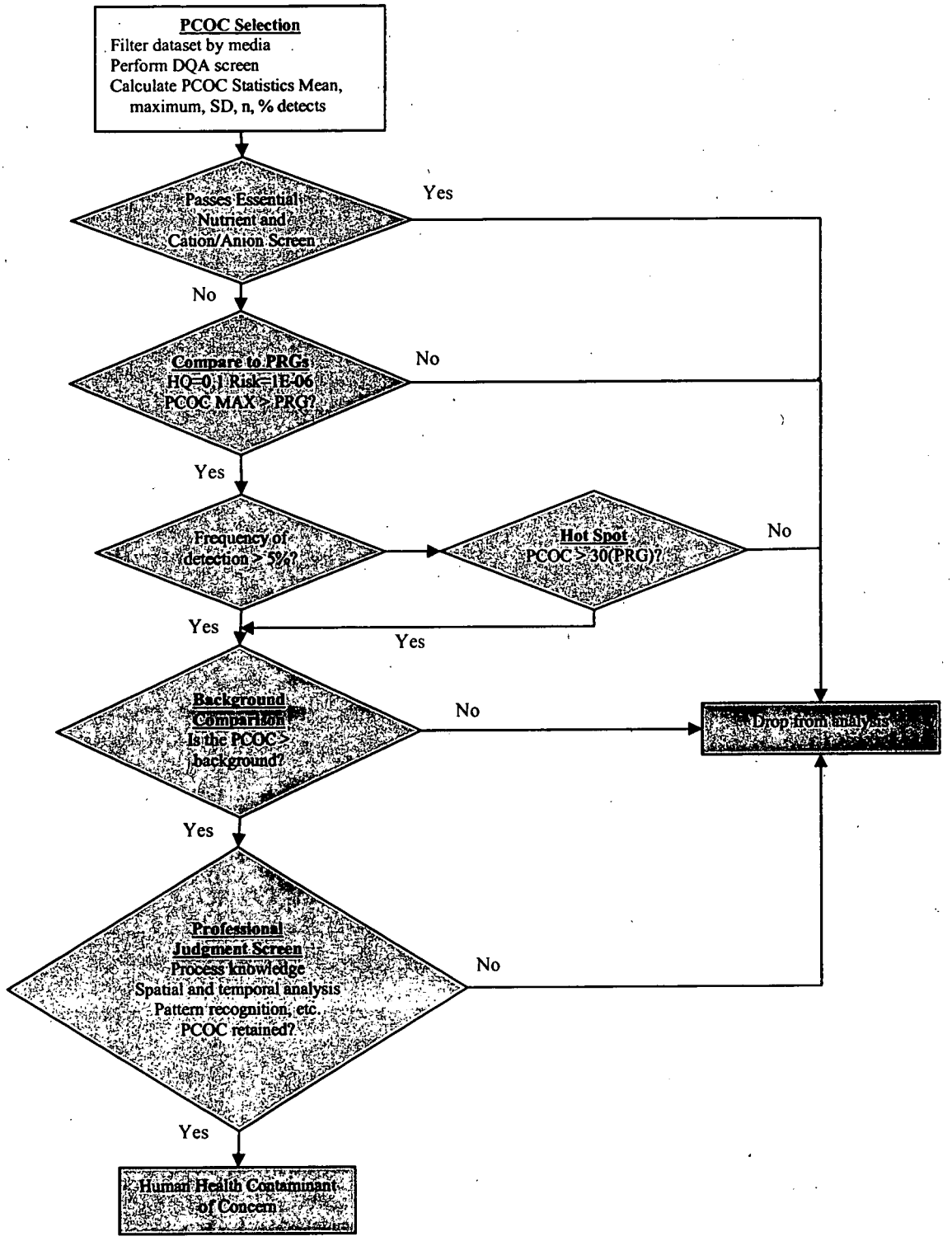
Figure 2.1 Human Health COC Selection Process



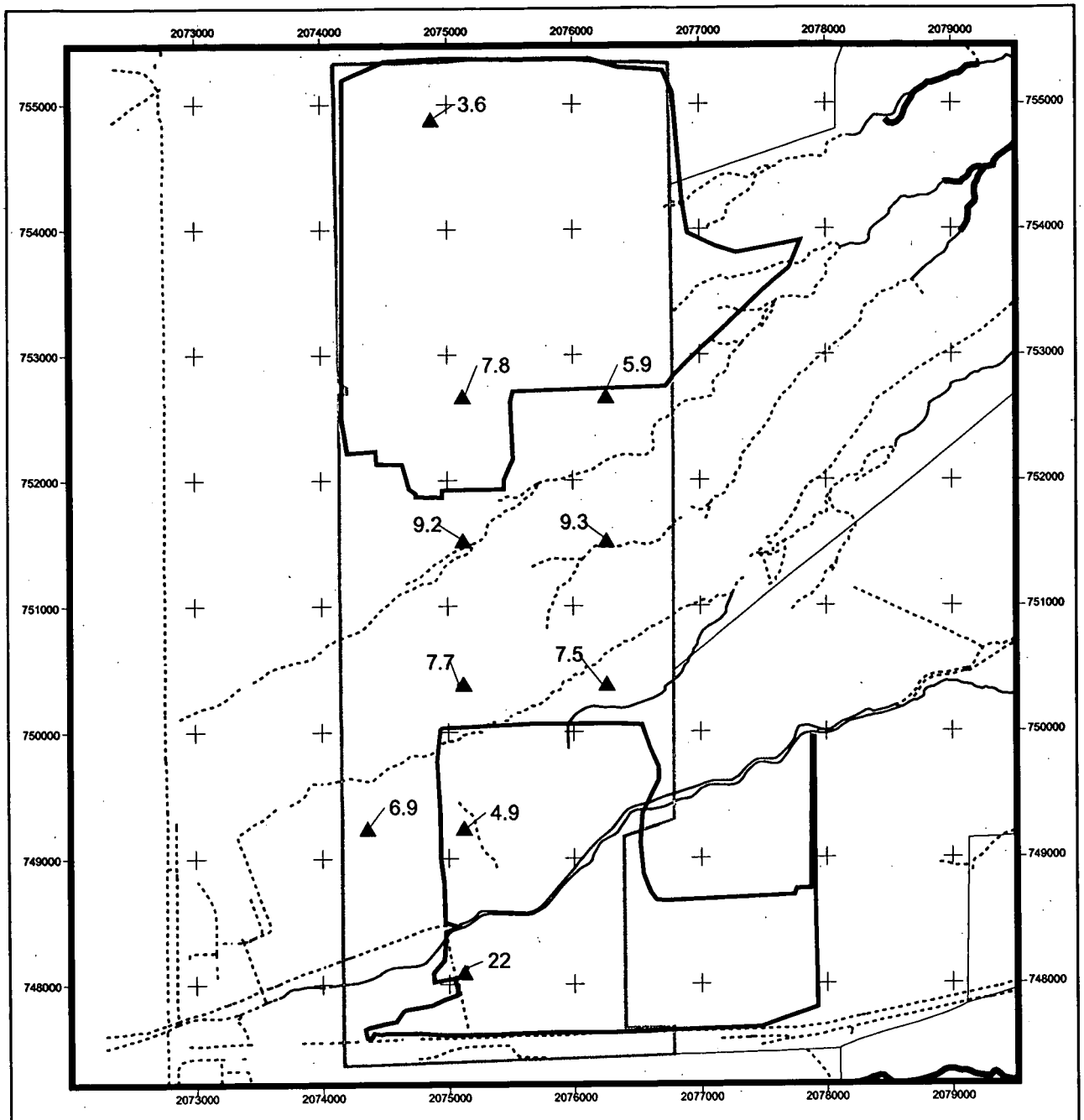


Figure 2.2
Arsenic Concentration in the West Area Exposure Unit (mg/kg)

KEY

- ▲ Surface soil sampling station
- 3.6 Arsenic concentration, mg/kg (PRG=2.4 mg/kg)
- Soil Disturbance Area
- West Area Exposure Unit
- Exposure unit

Stream

- Perennial
- Intermittent
- Ephemeral

N W E S

500 0 500 Feet

Scale 1:14,500

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 12.15.2004

Prepared by: RADMS

Prepared for: KAISER•HILL COMPANY

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Figure 2.3 Box Plot for Arsenic in Surface Soil

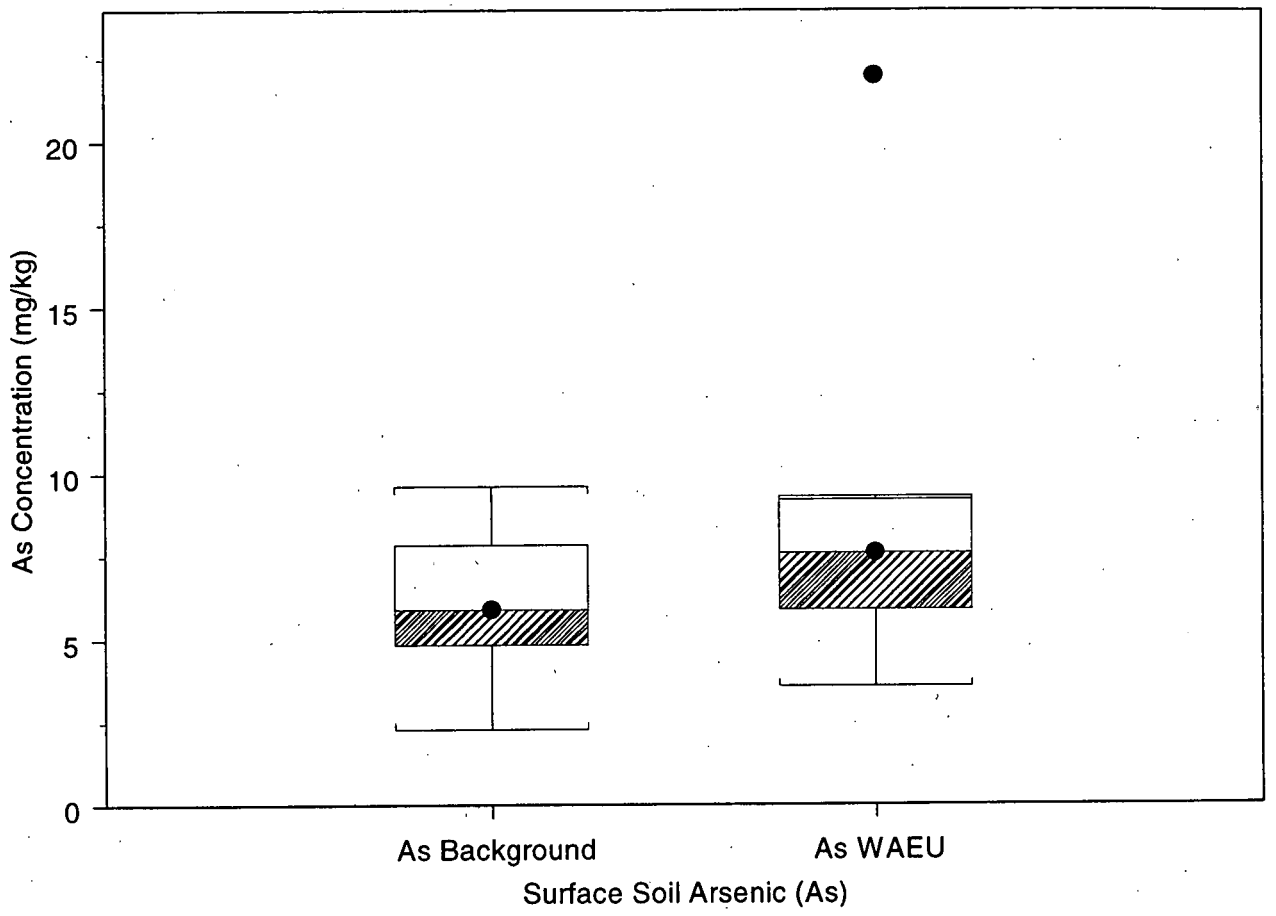


Figure 2.4 Box Plot for Arsenic in Sediment

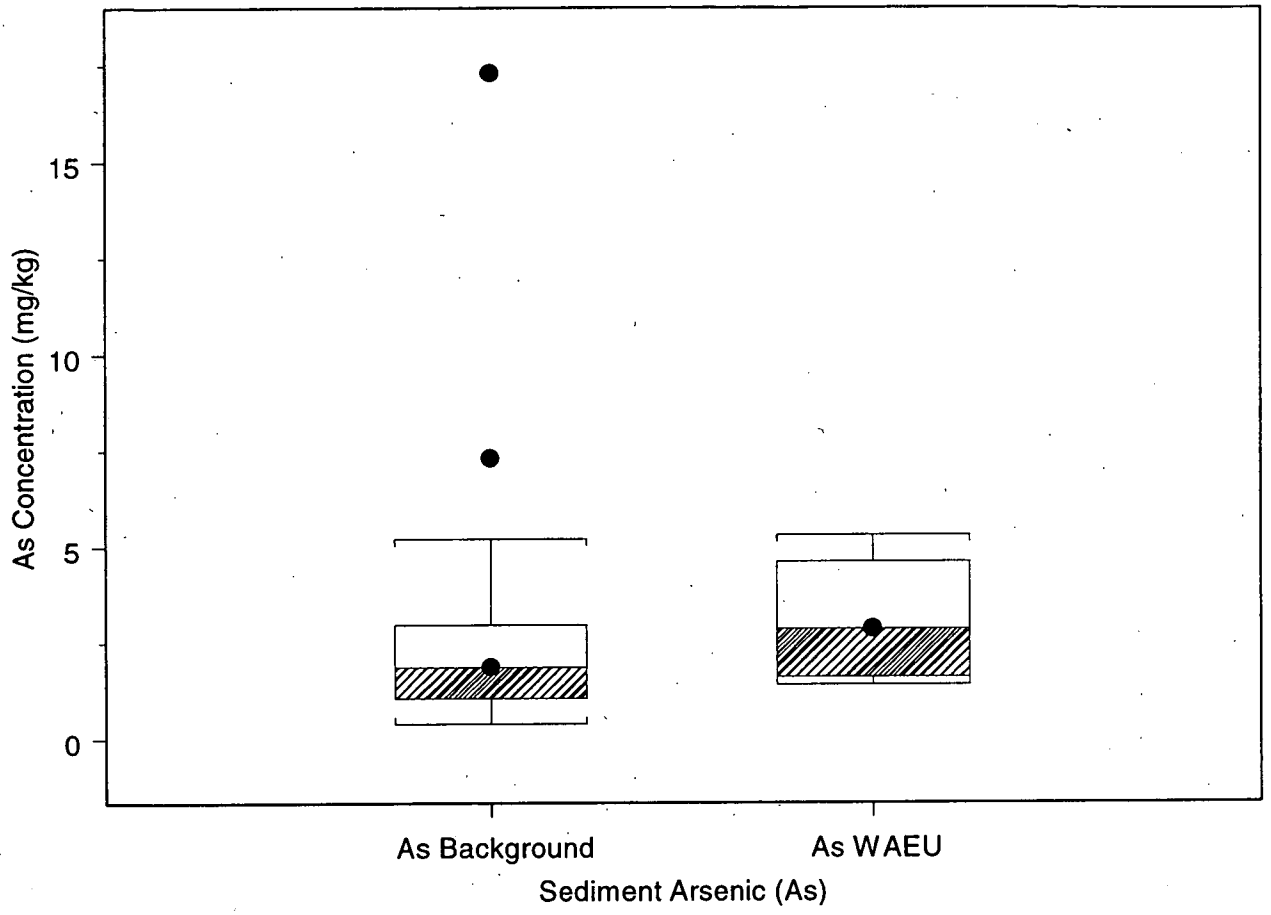


Figure 2.5 Box Plot for Radium-228 in Sediment

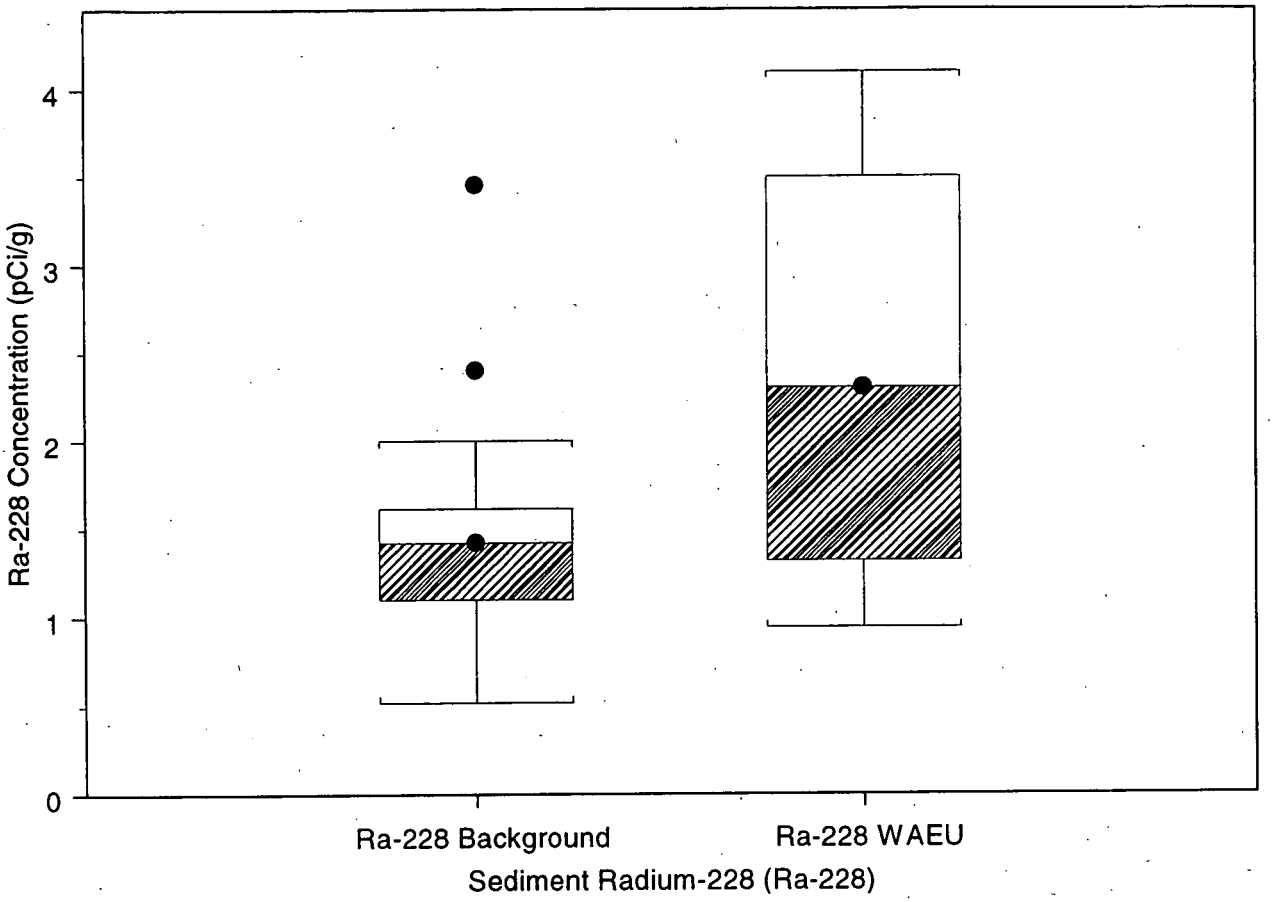


Figure 7.1 ECOPC Identification Process

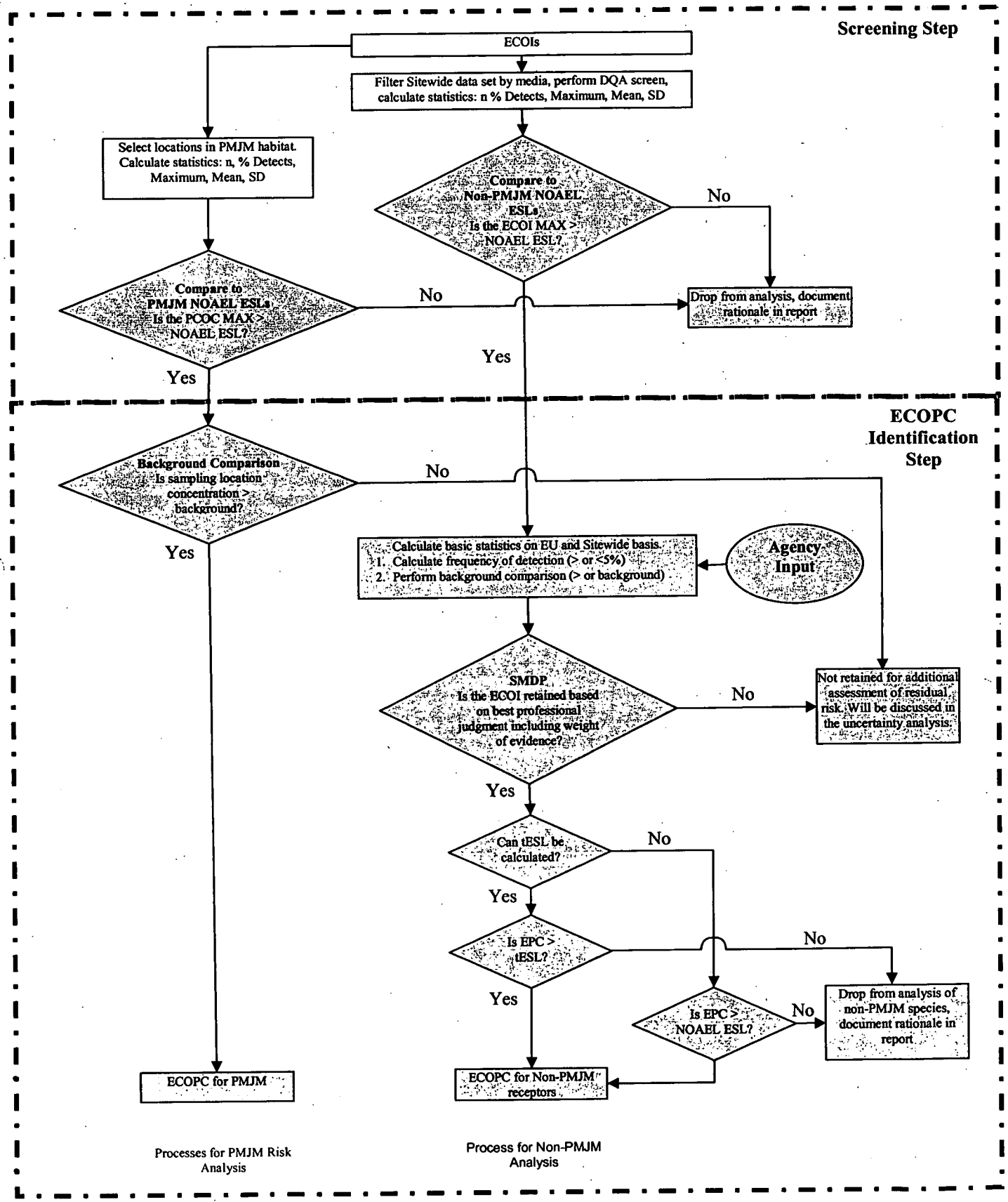


Figure 7.2 Box Plot for Chromium in Surface Soil

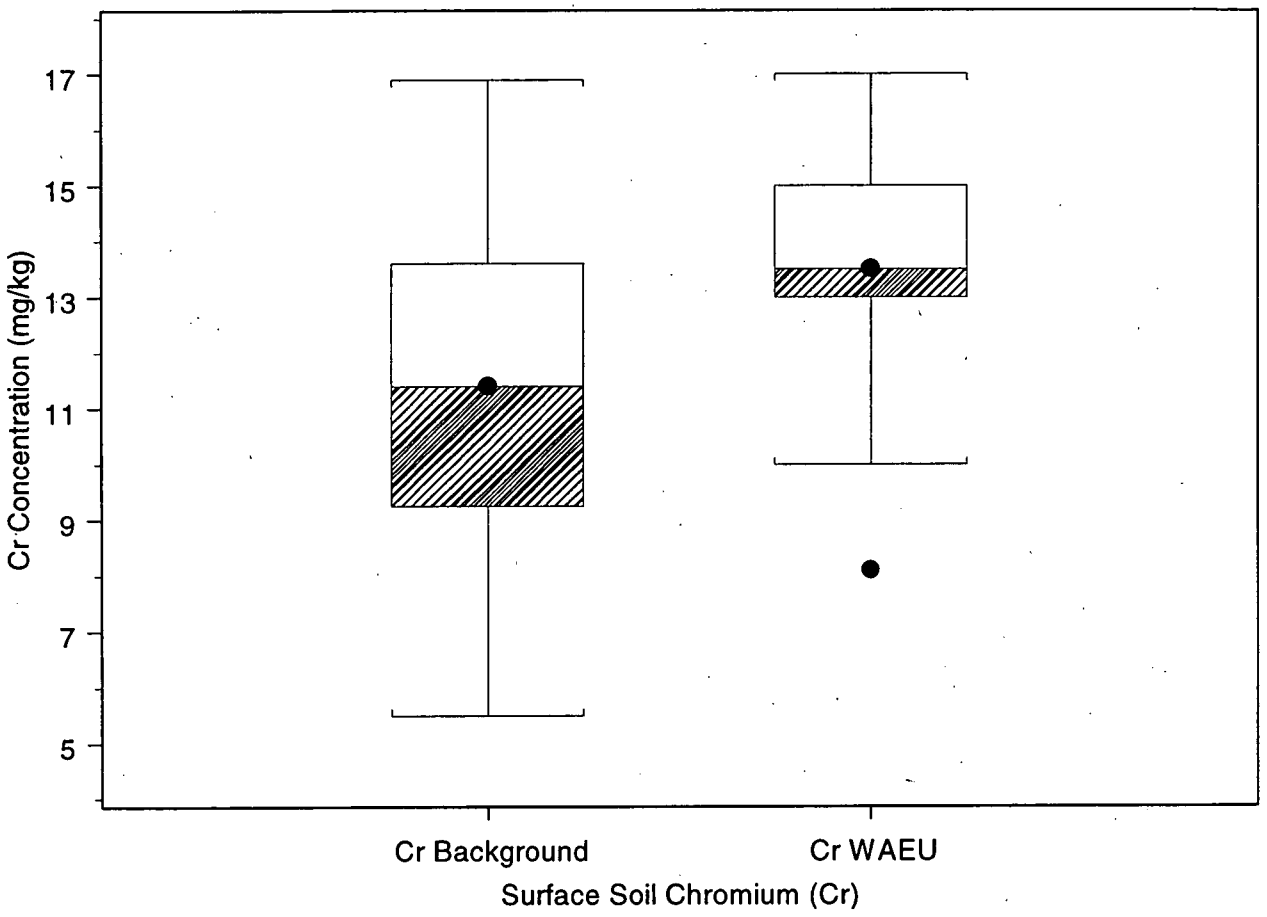


Figure 7.3 Box Plot for Lithium in Surface Soil

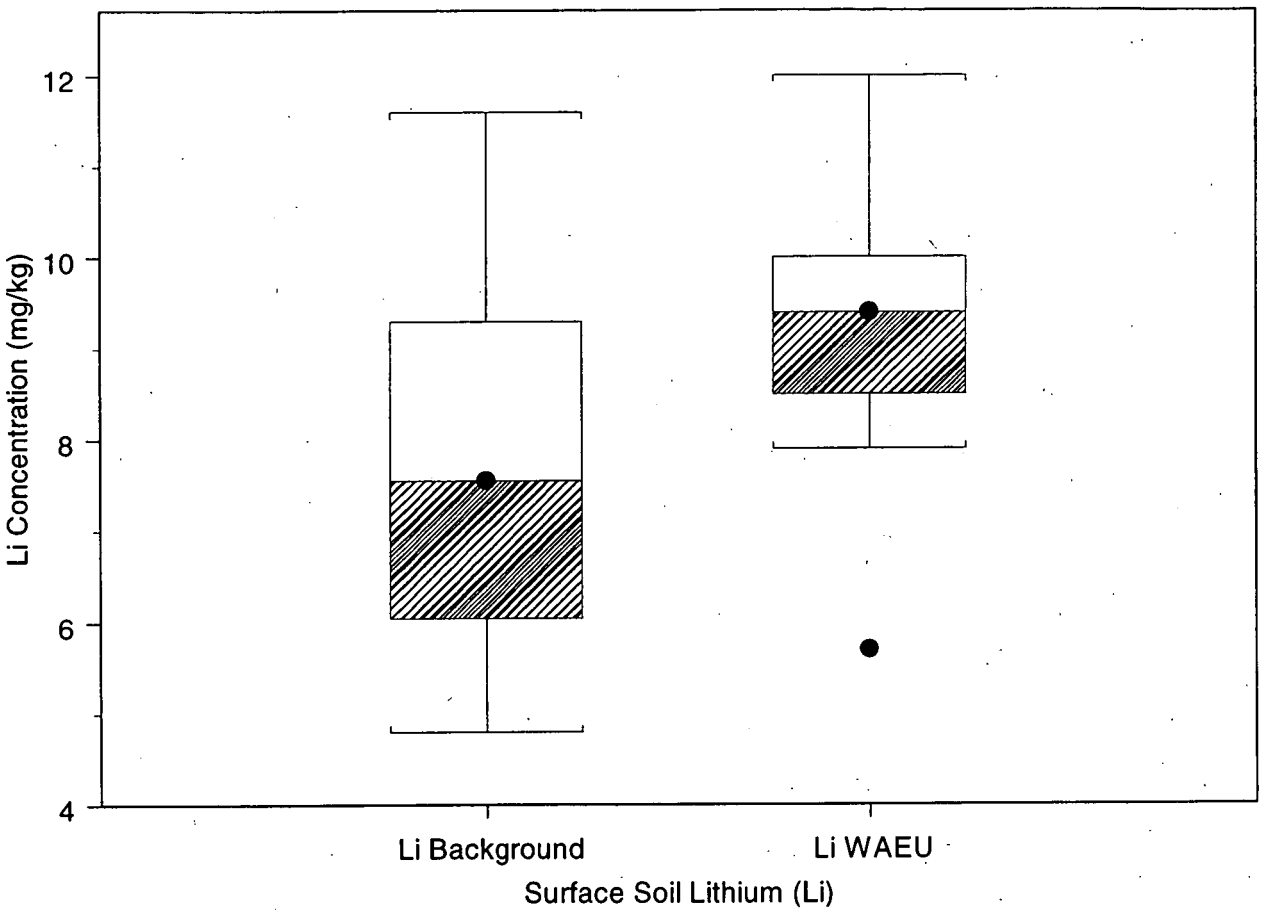
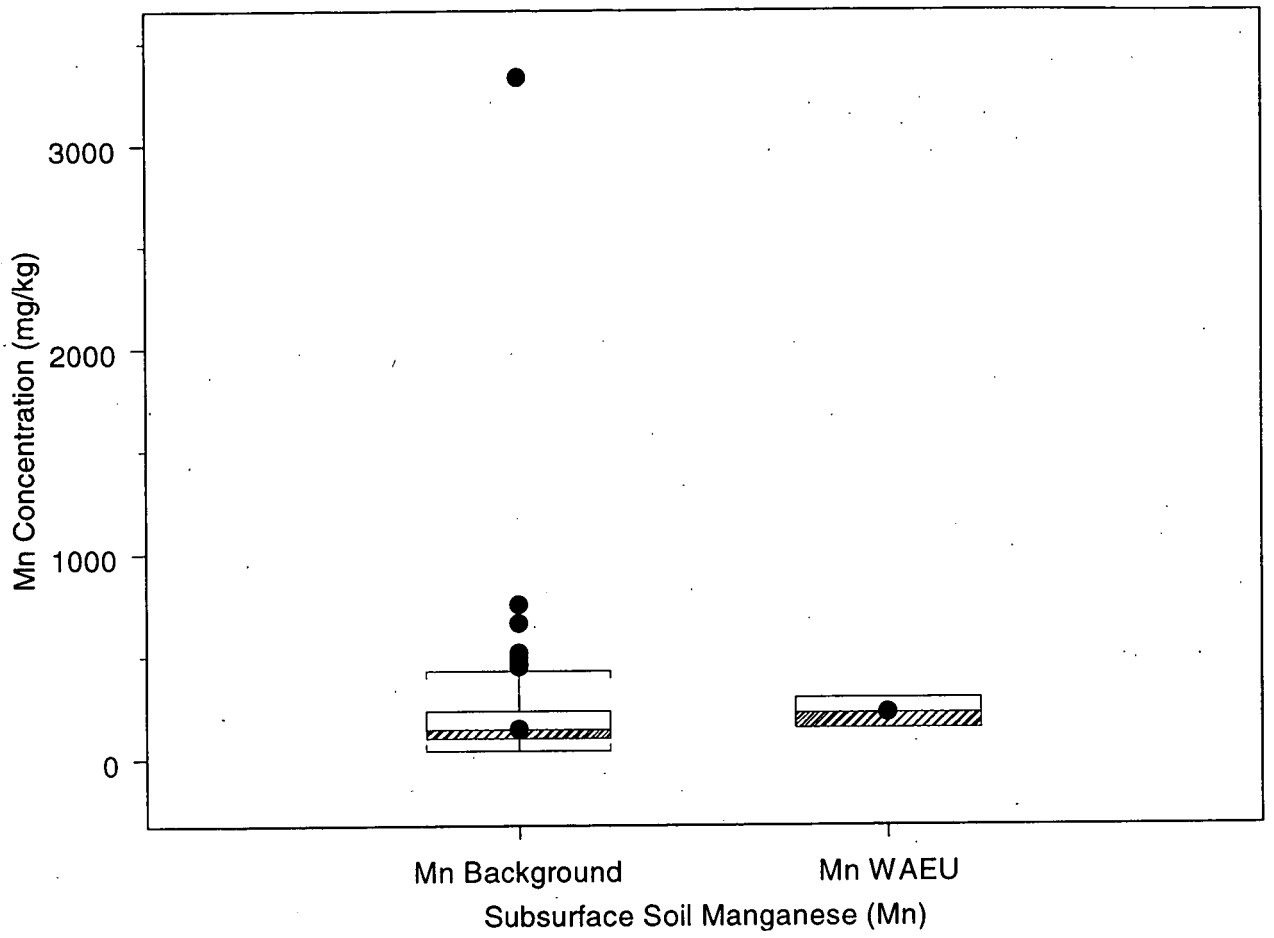


Figure 7.4 Box Plot for Manganese in Subsurface Soil



DRAFT COMPREHENSIVE RISK ASSESSMENT

VOLUME 3: APPENDIX A

Data for Pre-1991 and Non-detected Analytes

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ACRONYMS

CRA	Comprehensive Risk Assessment
ESL	ecological screening level
MaxDL	maximum detection limit
NA	not available or not applicable
NOAEL	no-observed-adverse-effect level
OU	Operable Unit
PAH	polyaromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness and comparability
PRG	preliminary remediation goal
tESL	threshold ecological screening level
WAEU	West Area Exposure Unit
WRW	Wildlife Refuge Worker

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1.0 EVALUATION OF DETECTION LIMITS FOR NONDETECTED ANALYTES IN THE WEST AREA EXPOSURE UNIT

Nondetects and the reported detection limits are listed for each medium in the West Area Exposure Unit (WAEU) and compared to medium-specific human health preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW) and ecological screening levels (ESLs) for a variety of receptors. The detection limits are considered adequate if they are less than the respective PRGs and ESLs.

Nondetected analytes in surface soil, subsurface soil, sediment, surface water, and groundwater are compared to PRGs. A comparison with ESLs is only conducted for surface and subsurface soil because sediment and surface water will be evaluated separately. Groundwater is not a medium of concern for ecological receptors.

1.1 Comparison of Maximum Detection Limits for Nondetected Analytes to PRGs

Nondetected analytes in surface soil, subsurface soil, sediment, surface water and groundwater are listed and maximum detection limits (MaxDLs) compared to PRGs in Tables A.1 through A.5. The detection limits for nondetects in surface soil, subsurface soil, surface water, and groundwater are all below their respective PRGs. For sediment, three nondetects, benzo(a)pyrene, dibenzo(a,h)anthracene, and nitrosodipropylamine had detection limits above their PRGs. The range of detection limits for benzo(a)pyrene and dibenz(a,h)anthracene was 330 – 950 mg/kg and that for nitrosodipropylamine 330 to 950 mg/kg. The PRG for these analytes are 379, 379, and 429 mg/kg, respectively. These values are less than the upper range of the detection limits, but exceed the lower range. The detection limits thus exceeded the PRGs for some, but not all of the 10 sediment samples collected in the WAEU. Polyaromatic hydrocarbons (PAHs) were detected in sediment in the WAEU prior to 1991, but only post 1991 data are used in the Comprehensive Risk Assessment (CRA). Therefore, there is some uncertainty associated with the elevated detection limits for PAHs in some of the sediment samples.

PRGs were not available for several organic nondetects in surface water and groundwater (Tables A.4 and A.5, respectively). However, the MaxDLs for other similar organic analytes were much lower than the respective PRGs (Tables A.4 and A.5). This, and the fact that there is no source for these analytes in groundwater or surface water at the WAEU, suggests that there is little uncertainty associated with the lack of PRGs for the analytes.

1.2 Comparison of Maximum Detection Limits for Nondetected Analytes to ESLs

The MaxDLs for nondetects in surface and subsurface soil are compared to no-observed-adverse-effects level (NOAEL)-based ESLs in Table A.6. All nondetected analytes in surface and subsurface soils were less than the corresponding ESLs, except for those for molybdenum and selenium in subsurface soil. The detection limit for molybdenum in subsurface soil was 40 mg/kg, slightly exceeding the NOAEL-based ESL of 27 mg/kg for the prairie dog. The MaxDLs for selenium was 1.1 mg/kg and the NOAEL ESL is 0.4 mg/kg. There are no threshold ESLs (tESLs) for either molybdenum or selenium for the prairie dog that could be compared to the detection limits. The slightly elevated detection

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limit for molybdenum will not substantially impact the conclusions of the ecological risk assessment.

Table A.1 Evaluation of Maximum Detection Limits for Nondetected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits (mg/kg)	Total Number of Samples	WRW PRG for Surface Soil (mg/kg)	MaxDL > PRG?
Cadmium	0.069 - 0.077	10	91.4	No
Selenium	0.85 - 0.95	10	555	No
Tin	0.89 - 1	10	66652	No
Uranium, Total	1.5 - 1.7	10	333	No

Table A.2 Evaluation of Detection Limits for Nondetected Analytes in Sediment

Analyte	Range of Reported Detection Limits	Total Number of Samples	WRW PRG for Sediment	MaxDL > PRG?
Inorganics (mg/kg)				
Mercury	0.04 - 0.21	10	32.9	No
Nitrite	0.02 - 0.02	2	11109	No
Selenium	0.29 - 1	10	555	No
Organics (ug/kg)				
1,1,1-Trichloroethane	5 - 14	10	9178628	No
1,1,2,2-Tetrachloroethane	5 - 14	10	10483	No
1,1,2-Trichloroethane	5 - 14	10	28022	No
1,1-Dichloroethane	5 - 14	10	2715777	No
1,1-Dichloroethene	5 - 14	10	17366	No
1,2,4-Trichlorobenzene	330 - 950	10	151360	No
1,2-Dichlorobenzene	330 - 950	10	2891221	No
1,2-Dichloroethane	5 - 14	10	13270	No
1,2-Dichloroethene (total)	5 - 14	10	999783	No
1,2-Dichloropropane	5 - 14	10	38427	No
1,4-Dichlorobenzene	330 - 950	10	91315	No
2,4,5-Trichlorophenol	1600 - 4800	10	8014354	No
2,4,6-Trichlorophenol	330 - 950	10	272055	No
2,4-Dichlorophenol	330 - 950	10	240431	No
2,4-Dimethylphenol	330 - 950	10	1602871	No
2,4-Dinitrophenol	1600 - 4800	10	160287	No
2,4-Dinitrotoluene	330 - 950	10	160287	No
2,6-Dinitrotoluene	330 - 950	10	80144	No
2-Chloronaphthalene	330 - 950	10	6411483	No
2-Chlorophenol	330 - 950	10	555435	No
2-Methylnaphthalene	330 - 950	10	320574	No

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Table A.2 Evaluation of Detection Limits for Nondetected Analytes in Sediment

Analyte	Range of Reported Detection Limits	Total Number of Samples	WRW PRG for Sediment	MaxDL => PRG?
2-Methylphenol	330 - 950	10	4007177	No
2-Nitroaniline	1600 - 4800	10	192137	No
3,3'-Dichlorobenzidine	660 - 1900	7	6667	No
4,4'-DDD	16 - 46	10	15528	No
4,4'-DDE	16 - 46	10	10961	No
4,4'-DDT	16 - 46	10	10927	No
4,6-Dinitro-2-methylphenol	1600 - 4800	10	8014	No
4-Chloro-3-methylphenol	330 - 950	10	NA	NA
4-Chloroaniline	330 - 950	10	320574	No
4-Methyl-2-pentanone	10 - 29	10	83210223	No
4-Nitroaniline	1600 - 4800	8	207917	No
4-Nitrophenol	1600 - 4800	9	641148	No
Acenaphthene	330 - 950	10	4437768	No
Acenaphthylene	330 - 950	10	NA	NA
Acetone	10 - 29	7	99978261	No
Aldrin	8 - 23	10	176	No
alpha-BHC	8 - 23	10	570	No
alpha-Chlordane	16 - 230	10	10261	No
Anthracene	330 - 950	10	22188842	No
Aroclor-1016	80 - 230	10	1349	No
Aroclor-1221	80 - 230	10	1349	No
Aroclor-1232	80 - 230	10	1349	No
Aroclor-1242	80 - 230	10	1349	No
Aroclor-1248	80 - 230	10	1349	No
Aroclor-1254	160 - 460	10	1349	No
Aroclor-1260	160 - 460	10	1349	No
Benzene	5 - 14	10	23563	No
Benzo(a)anthracene	330 - 950	10	3793	No
Benzo(a)pyrene	330 - 950	10	379	Yes
Benzo(b)fluoranthene	330 - 950	10	3793	No
Benzo(g,h,i)perylene	330 - 950	9	NA	NA
Benzo(k)fluoranthene	330 - 950	10	37927	No
Benzyl Alcohol	330 - 950	10	24043061	No
beta-BHC	8 - 23	10	1995	No
beta-Chlordane	16 - 230	10	10261	No
bis(2-Chloroethyl)ether	330 - 950	10	3767	No
bis(2-Chloroisopropyl)ether	330 - 950	10	59301	No
Bromodichloromethane	5 - 14	10	67070	No
Bromoform	5 - 14	10	419858	No
Bromomethane	10 - 29	9	20959	No
Butylbenzylphthalate	330 - 950	9	16028707	No

Table A.2 Evaluation of Detection Limits for Nondetected Analytes in Sediment

Analyte	Range of Reported Detection Limits	Total Number of Samples	WRW PRG for Sediment	MaxDL > PRG?
Carbon Disulfide	5 - 14	10	1637032	No
Carbon Tetrachloride	5 - 14	10	8446	No
Chlorobenzene	5 - 14	10	666523	No
Chloroethane	10 - 29	9	1433909	No
Chloroform	5 - 14	10	7850	No
Chloromethane	10 - 29	10	115077	No
Chrysene	330 - 950	10	379269	No
cis-1,3-Dichloropropene	5 - 14	10	19432	No
delta-BHC	8 - 23	10	NA	NA
Dibenz(a,h)anthracene	330 - 950	10	379	Yes
Dibenzofuran	330 - 950	10	222174	No
Dibromochloromethane	5 - 14	10	49504	No
Dieldrin	16 - 46	10	187	No
Diethylphthalate	330 - 950	10	64114830	No
Dimethylphthalate	330 - 950	10	*801435369*	No
Di-n-octylphthalate	330 - 950	10	3205741	No
Endosulfan I	8 - 23	10	480861	No
Endosulfan II	16 - 46	10	480861	No
Endosulfan sulfate	16 - 46	10	480861	No
Endrin	16 - 46	10	24043	No
Endrin ketone	16 - 46	10	33326	No
Ethylbenzene	5 - 14	10	5385973	No
Fluorene	330 - 950	10	3205741	No
gamma-BHC	8 - 23	10	2771	No
Heptachlor	8 - 23	10	665	No
Heptachlor epoxide	8 - 23	10	329	No
Hexachlorobenzene	330 - 950	10	1870	No
Hexachlorobutadiene	330 - 950	10	22217	No
Hexachlorocyclopentadiene	330 - 950	10	380452	No
Hexachloroethane	330 - 950	10	111087	No
Indeno(1,2,3-cd)pyrene	330 - 950	9	3793	No
Isophorone	330 - 950	10	3157922	No
m-Dichlorobenzene	330 - 950	10	3332609	No
Methoxychlor	80 - 230	10	400718	No
Methylene chloride	5 - 14	10	271792	No
Naphthalene	330 - 950	10	1403301	No
Nitrobenzene	330 - 950	10	43246	No
n-Nitrosodiphenylamine	330 - 950	10	612250	No
n-Nitrosodipropylamine	330 - 950	10	429	Yes
Pentachlorophenol	1600 - 4800	10	17633	No
Phenanthrene	330 - 950	10	NA	NA

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Table A.2 Evaluation of Detection Limits for Nondetected Analytes in Sediment

Analyte	Range of Reported Detection Limits	Total Number of Samples	WRW PRG for Sediment	MaxDL > PRG?
Phenol	330 - 950	10	24043061	No
Styrene	5 - 14	10	13789257	No
Tetrachloroethene	5 - 14	10	6705	No
Toxaphene	160 - 460	10	2720	No
trans-1,3-Dichloropropene	5 - 14	10	20820	No
Trichloroethene	5 - 14	10	1770	No
Vinyl acetate	10 - 29	10	2647023	No
Vinyl chloride	10 - 29	10	2169	No
Xylene	5 - 14	10	1059049	No

Table A.3 Evaluation of Maximum Detection Limits for Nondetected Analytes in Subsurface Soil < 8 feet

Analyte	Range of Reported Values a (mg/kg)	Total Number of Samples	Subsoil WRW PRG (mg/kg)	MaxDL > PRG?
Antimony	10.6 - 11.8	2	511	No
Cadmium	0.95 - 1	2	1051	No
Mercury	0.05 - 0.06	2	379	No
Molybdenum	3.7 - 4.1	2	6387500	No
Selenium	0.21 - 0.24	2	6388	No
Silver	0.86 - 0.95	2	6388	No

a - No detection limit was reported. Therefore, the range of reported values was used.

Table A.4 Evaluation of Maximum Detection Limits for Nondetected Analytes in Surface Water

Analyte	Range of Reported Detection Limits (ug/L)	Total Number of Samples	WRW PRG for Surface Water (ug/L)	MaxDL > PRG?
1,1,1-Trichloroethane	5	16	567778	No
1,1,2,2-Tetrachloroethane	5	16	380	No
1,1,2-Trichloroethane	5	16	1332	No
1,1-Dichloroethane	5	16	202778	No
1,1-Dichloroethene	5	16	101389	No
1,2,4-Trichlorobenzene	10	1	20278	No
1,2-Dichlorobenzene	10	1	182500	No
1,2-Dichloroethane	5	16	834	No
1,2-Dichloroethene (total)	5	16	18250	No
1,2-Dichloropropane	5	16	1116	No

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Table A.4 Evaluation of Maximum Detection Limits for Nondetected Analytes in Surface Water

Analyte	Range of Reported Detection Limits (ug/L)	Total Number of Samples	WRW PRG for Surface Water (ug/L)	MaxDL > PRG?
1,4-Dichlorobenzene	1	1	3163	No
2,4,5-Trichlorophenol	51	1	202778	No
2,4,6-Trichlorophenol	10	1	6901	No
2,4-Dichlorophenol	10	1	6083	No
2,4-Dimethylphenol	10	1	40556	No
2,4-Dinitrophenol	51	1	4056	No
2,4-Dinitrotoluene	10	1	4056	No
2,6-Dinitrotoluene	10	1	2028	No
2-Chloronaphthalene	10	1	162222	No
2-Chlorophenol	10	1	10139	No
2-Hexanone	10	16	NA	NA
2-Methylnaphthalene	10	1	8111	No
2-Methylphenol	10	1	101389	No
2-Nitroaniline	51	1	6083	No
2-Nitrophenol	10	1	NA	NA
3,3'-Dichlorobenzidine	20	1	169	No
3-Nitroaniline	51	1	NA	NA
4,4'-DDD	0.1	1	316	No
4,4'-DDE	0.1	1	223	No
4,4'-DDT	0.1	1	223	No
4,6-Dinitro-2-methylphenol	51	1	203	No
4-Bromodiphenyl ether	10	1	NA	NA
4-Chloro-3-methylphenol	10	1	NA	NA
4-Chloroaniline	10	1	8111	No
4-Chlorophenyl phenyl ether	10	1	NA	NA
4-Methyl-2-pentanone	10	15	NA	NA
4-Methylphenol	10	1	10139	No
4-Nitroaniline	51	1	3795	No
4-Nitrophenol	51	1	16222	No
Acenaphthene	10	1	121667	No
Acenaphthylene	10	1	NA	NA
Aldrin	0.052	1	4.47	No
alpha-BHC	0.052	1	12	No
alpha-Chlordane	0.52	1	217	No
Anthracene	10	1	608333	No
Aroclor-1221	0.52	1	38.0	No
Aroclor-1232	0.52	1	38.0	No
Aroclor-1242	0.52	1	38.0	No
Aroclor-1248	0.52	1	38.0	No

Table A.4 Evaluation of Maximum Detection Limits for Nondetected Analytes in Surface Water

Analyte	Range of Reported Detection Limits (ug/L)	Total Number of Samples	WRW PRG for Surface Water (ug/L)	MaxDL > PRG?
Aroclor-1254	1	1	38.0	No
Aroclor-1260	1	1	38.0	No
Benzene	5	16	1380	No
Benzo(a)anthracene	10	1	104	No
Benzo(a)pyrene	10	1	10.4	No
Benzo(b)fluoranthene	10	1	104	No
Benzo(g,h,i)perylene	10	1	NA	NA
Benzo(k)fluoranthene	10	1	1040	No
Benzoic Acid	51	1	8111111	No
Benzyl Alcohol	10	1	608333	No
beta-BHC	0.052	1	42.2	No
beta-Chlordane	0.52	1	217	No
bis(2-Chloroethoxy)methane	10	1	NA	NA
bis(2-Chloroethyl)ether	10	1	69.0	No
bis(2-Chloroisopropyl)ether	10	1	NA	NA
bis(2-Ethylhexyl)phthalate	10	1	5422	No
Bromodichloromethane	5	16	1224	No
Bromoform	5	16	9608	No
Bromomethane	10	16	2839	No
Butylbenzylphthalate	10	1	405556	No
Carbon Disulfide	5	16	202778	No
Carbon Tetrachloride	5	16	584	No
Chlorobenzene	5	16	40556	No
Chloroethane	10	16	26175	No
Chloroform	5	16	20278	No
Chloromethane	10	16	NA	NA
Chrysene	10	1	10398	No
cis-1,2-Dichloroethene	0.52	1	38.0	No
cis-1,3-Dichloropropene	5	16	759	No
delta-BHC	0.052	1	NA	NA
Dibenz(a,h)anthracene	10	1	10.4	No
Dibenzofuran	10	1	4056	No
Dibromochloromethane	5	16	904	No
Dieldrin	0.1	1	4.74	No
Diethylphthalate	10	1	1622222	No
Dimethylphthalate	10	1	20277778	No
Di-n-butylphthalate	10	1	202778	No
Di-n-octylphthalate	10	1	81111	No
Endosulfan I	0.052	1	12167	No
Endosulfan II	0.1	1	12167	No

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Table A.4 Evaluation of Maximum Detection Limits for Nondetected Analytes in Surface Water

Analyte	Range of Reported Detection Limits (ug/L)	Total Number of Samples	WRW PRG for Surface Water (ug/L)	MaxDL > PRG?
Endosulfan sulfate	0.1	1	12167	No
Endrin	0.1	1	608	No
Endrin ketone	0.1	1	608	No
Ethylbenzene	5	16	202778	No
Fluoranthene	10	1	81111	No
Fluorene	10	1	81111	No
gamma-BHC	0.052	1	58.4	No
Heptachlor	0.052	1	16.9	No
Heptachlor epoxide	0.052	1	8.34	No
Hexachlorobenzene	10	1	47.4	No
Hexachlorobutadiene	10	1	406	No
Hexachlorocyclopentadiene	10	1	12167	No
Hexachloroethane	10	1	2028	No
Indeno(1,2,3-cd)pyrene	10	1	104	No
Isophorone	10	1	79901	No
m-Dichlorobenzene	10	1	60833	No
Methoxychlor	0.52	1	10139	No
Naphthalene	10	1	40556	No
Nitrobenzene	10	1	1014	No
n-Nitrosodiphenylamine	10	1	15491	No
n-Nitrosodipropylamine	10	1	10.8	No
Pentachlorophenol	51	1	633	No
Phenanthrene	10	1	NA	NA
Phenol	10	1	608333	No
Pyrene	10	1	60833	No
Styrene	5	16	405556	No
Tetrachloroethene	5	16	141	No
Toluene	5	16	405556	No
Toxaphene	1	1	69.0	No
trans-1,3-Dichloropropene	5	16	759	No
Trichloroethene	5	16	190	No
Vinyl acetate	10	16	2027778	No
Vinyl chloride	10	16	50.6	No
Xylene	5	16	405556	No

NA = Not available or not applicable

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Table A.5 Evaluation of Maximum Detection Limits for Nondetected Volatile Analytes in Groundwater

Analyte	Range of Reported Detection Limits (ug/L)	Total Number of Samples	Groundwater Volatilization Screening-Level PRG (ug/L)	MaxDL > PRG?
1,1,1,2-Tetrachloroethane	0.2 - 1	28	9.07E-02	No
1,1,1-Trichloroethane	0.1 - 5	54	8.80E+04	No
1,1-Dichloroethane	0.1 - 5	54	3.38E+04	No
1,1-Dichloroethene	0.1 - 5	54	1.39E+02	No
1,1-Dichloropropene	0.1 - 1	28	NA	NA
1,2,3-Trichlorobenzene	0.1 - 1	28	NA	NA
1,2,3-Trichloropropane	0.4 - 1	24	5.62E+01	No
1,2,4-Trichlorobenzene	0.2 - 10	29	1.32E+03	No
1,2-Dibromo-3-chloropropane	0.5 - 1	6	NA	NA
1,2-Dibromoethane	0.2 - 1	26	NA	NA
1,2-Dichlorobenzene	0.1 - 10	29	3.14E+04	No
1,2-Dichloroethane	0.2 - 5	54	4.19E+02	No
1,2-Dichloroethene (total)	5 - 5	26	NA	NA
1,2-Dichloropropane	0.1 - 5	53	2.44E+02	No
1,3-Dichloropropane	0.2 - 1	28	NA	NA
1,4-Dichlorobenzene	0.2 - 10	29	NA	NA
2,2-Dichloropropane	0.1 - 1	28	NA	NA
2-Butanone	10 - 10	15	2.20E+07	No
2-Chlorotoluene	0.2 - 1	28	NA	NA
2-Hexanone	10 - 10	23	NA	NA
4-Isopropyltoluene	0.2 - 1	28	NA	NA
Acetone	10 - 10	26	2.0E+06	No
Benzene	0.1 - 5	54	3.41E+02	No
Benzene, 1,2,4-trimethyl	0.2 - 1	28	NA	NA
Benzene, 1,3,5-trimethyl-	0.1 - 1	28	NA	NA
Bromobenzene	0.1 - 1	28	NA	NA
Bromochloromethane	0.2 - 1	27	NA	NA
Bromodichloromethane	0.2 - 5	54	NA	NA
Bromomethane	0.1 - 10	53	2.71E+02	No
Chlorobenzene	0.1 - 5	54	6.64E+03	No
Chloroethane	0.1 - 10	53	3.94E+05	No
Chloromethane	0.2 - 10	54	1.97E+03	No
cis-1,2-Dichloroethene	0.2 - 1	28	4.19E+02	No
cis-1,3-Dichloropropene	0.1 - 5	52	3.74E+02	No
Dibromochloromethane	0.2 - 5	54	6.41E+02	No
Dibromomethane	0.2 - 1	28	NA	NA
Dichlorodifluoromethane	0.2 - 1	28	1.76E+03	No
Ethylbenzene	0.1 - 5	54	7.09E+04	No
Isopropylbenzene	0.2 - 1	28	1.94E+03	No

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Table A.5 Evaluation of Maximum Detection Limits for Nondetected Volatile Analytes in Groundwater

Analyte	Range of Reported Detection Limits (ug/L)	Total Number of Samples	Groundwater Volatilization Screening Level PRG (ug/L)	MaxDL > PRG?
m+p Xylene	0.2 - 0.5	17	7.0E+03	No
m-Dichlorobenzene	0.1 - 10	29	NA	NA
m-Xylene	0.2 - 0.2	1	7.0E+03	No
Naphthalene	0.2 - 10	29	2.63E+03	No
n-Butylbenzene	0.1 - 1	28	NA	NA
n-Propylbenzene	0.2 - 1	28	NA	NA
o-Xylene	0.2 - 0.5	18	7.0E+03	No
p-Chlorotoluene	0.2 - 1	28	NA	NA
p-Xylene	0.2 - 0.2	1	7.0E+03	No
sec-Butylbenzene	0.2 - 1	28	NA	NA
Styrene	0.1 - 5	54	1.5E+05	No
trans-1,2-Dichloroethene	0.1 - 1	28	NA	NA
trans-1,3-Dichloropropene	0.3 - 5	52	3.72E+02	No
Trichlorofluoromethane	0.1 - 1	28	1.07E+04	No
Vinyl acetate	10 - 10	26	1.11E+05	No
Vinyl chloride	0.2 - 10	54	9.75E+01	No
Xylene	0.5 - 5	36	7.0E+03	No

NA = Not available or not applicable

Table A.6 Comparison of Maximum Detection Limits for Non- Detected Analytes to Ecological Screening Levels

Medium	Analyte	Maximum Detection Limit (mg/kg)	NOAEL-Based ESL (mg/kg)	MaxDL >ESL?
Surface Soil	Antimony	0.34	0.90	No
	Cadmium	0.35	0.71	No
	Selenium	1.1	0.42	Yes
	Silver	0.093	NA	NA
	Thallium	1	7.24	No
	Tin	2.2	2.9	No
Subsurface Soil	Antimony	12	18.72	No
	Cadmium	1	197.65	No
	Mercury	0.1	3.15	No
	Molybdenum	40	27.14	Yes
	Silver	2	NA	NA

NA = Not Available or not applicable

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2.0 DATA SUMMARY FOR SUBSURFACE SOIL > 8 FEET

A summary of detected analytes in subsurface soil > 8 feet is presented in Table A.7. The summary includes; number of samples, detection frequency, range of detected concentrations, arithmetic mean, and standard deviation. A variety of inorganic and radionuclide analytes were detected in subsurface soil > 8 feet in the WAEU.

Table A.7 Summary of Detects in Subsurface Soil (> 8 feet)

Analyte	Reported Detection Limits	Number of Samples	Detection Frequency (%)	Maximum Detect	Minimum Detect	Mean[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	NA	14	100%	8660	2810	5674	1549
Arsenic	NA	14	93%	6.8	1.2	2.5	1.6
Barium	NA	14	100%	92.5	16.4	46.4	16.9
Beryllium	NA	13	46%	0.77	0.26	0.25	0.2
Chromium	NA	14	100%	17.2	4.2	8.2	3.2
Cobalt	NA	14	100%	8.6	2.7	4.5	1.9
Copper	NA	14	93%	16.5	5.3	8.1	3.3
Iron	NA	14	100%	22500	3980	9238	4341
Lead	NA	14	100%	9.3	1.4	4.5	2.4
Manganese	NA	14	100%	270	35	108	54.5
Molybdenum	NA	14	7%	4.7	4.7	2.0	0.77
Nickel	NA	14	86%	23.8	7.4	10.4	5.2
Silver	NA	14	14%	0.98	0.98	0.50	0.2
Strontium	NA	14	100%	51.6	5.6	12.4	11.4
Tin	NA	14	21%	17.5	14	9.5	4.5
Vanadium	NA	14	100%	85.3	7.3	23.8	19.5
Zinc	NA	14	100%	49.6	6.2	16.9	10.2
Radionuclides (pCi/g)							
Americium-241	NA	2	NA	0.0115	0.00414	0.008	0.005
Plutonium-239/240	NA	2	NA	0.0224	0.0122	0.02	0.007
Uranium-234	NA	2	NA	0.919	0.578	0.7	0.2
Uranium-235	NA	2	NA	0.0444	0.0211	0.03	0.016
Uranium-238	NA	2	NA	0.8	0.637	0.72	0.12

[a] – For inorganics the value includes ½ the detection limits for nondetects, for radionuclides all reported values are included.
NA = Not applicable. All radionuclide values are considered detects.

3.0 DATA NOT USED IN THE CRA

Data from June 28, 1991 and forward are used for the CRA; all data collected before this date are not used. This evaluation focuses on data from sampling locations not targeted in the post-1991 investigations. Older data for sampling stations re-sampled after 1991 data

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are not considered here, because the more recent data are considered representative for these locations.

In addition, any datasets more recent than 1991 but excluded due to data quality considerations (for example, field screening data) are discussed in this section. Single data points of a usable dataset that are excluded due to data quality considerations are discussed in the precision, accuracy, representativeness, completeness, and comparability (PARCC) assessment (Section 1.2.3).

3.1 Surface Soil

In 1986, surface soil samples were collected in a circular area that included portions of the WAEU and part of Operable Unit (OU) 11, the West Spray Field, as described in (DOE 1992). Nine randomly selected locations were sampled within a 400-foot diameter area as shown in Figure A.1. Samples from the "surface," 0 to 6 inches, and 6- to 12-inch intervals were collected at each location.

Composites of the soil samples were prepared by combining the nine samples for each discrete depth interval. The purpose for the data collection in this area was to obtain background data for comparisons with samples collected in OU 11.

The 1986 data for metals in the composites for the two upper layers of soil (surface and 0 to 6 inches) are compared to the CRA surface (0 to 6 inches) soil data in Table A.8. The comparison shows that the concentrations reported in the 1986 data are similar to the post 1991 data used in the CRA. This indicates that no important information is omitted by not including the data from 1986.

Table A.8 Comparison of 1986 Soil Data with the CRA Soil Data

Analyte	1986 Data		CRA Data	
	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Maximum Detected Concentration
Inorganics (mg/kg)				
Aluminum	6540	9140	8200	18000
Arsenic	6.8	7	3.6	22
Iron	9080	12300	8900	16000
Lead	17	48	9.9	48
Manganese	215	337	150	320
Vanadium	6.4	6.4	19	34
Zinc	25	39	21	50
Radionuclides (pCi/g)				
Americium-241	0.01	0.05	-0.016	0.080
Plutonium-239	0.04	0.15	-0.078	0.25
Uranium-233/234	0.73	1.2	0.71	1.27
Uranium-238	0.8	1.2	0.678	1.7

4.0 SEDIMENT BACKGROUND DATA

The background data for RFETS are presented and discussed in Volume 2 of the CRA. Background data for sediment used for statistical comparisons with data in the WAEU are attached as tables A-9 and A-10, respectively. These data differ from those presented in Volume 2 in that data from locations in the WAEU have been removed.

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5.0 REFERENCES

DOE, 1992, Environmental Restoration Final Phase 1 RFI/RI Work Plan for OU 11 (West Spray Field). September 14, 1992.

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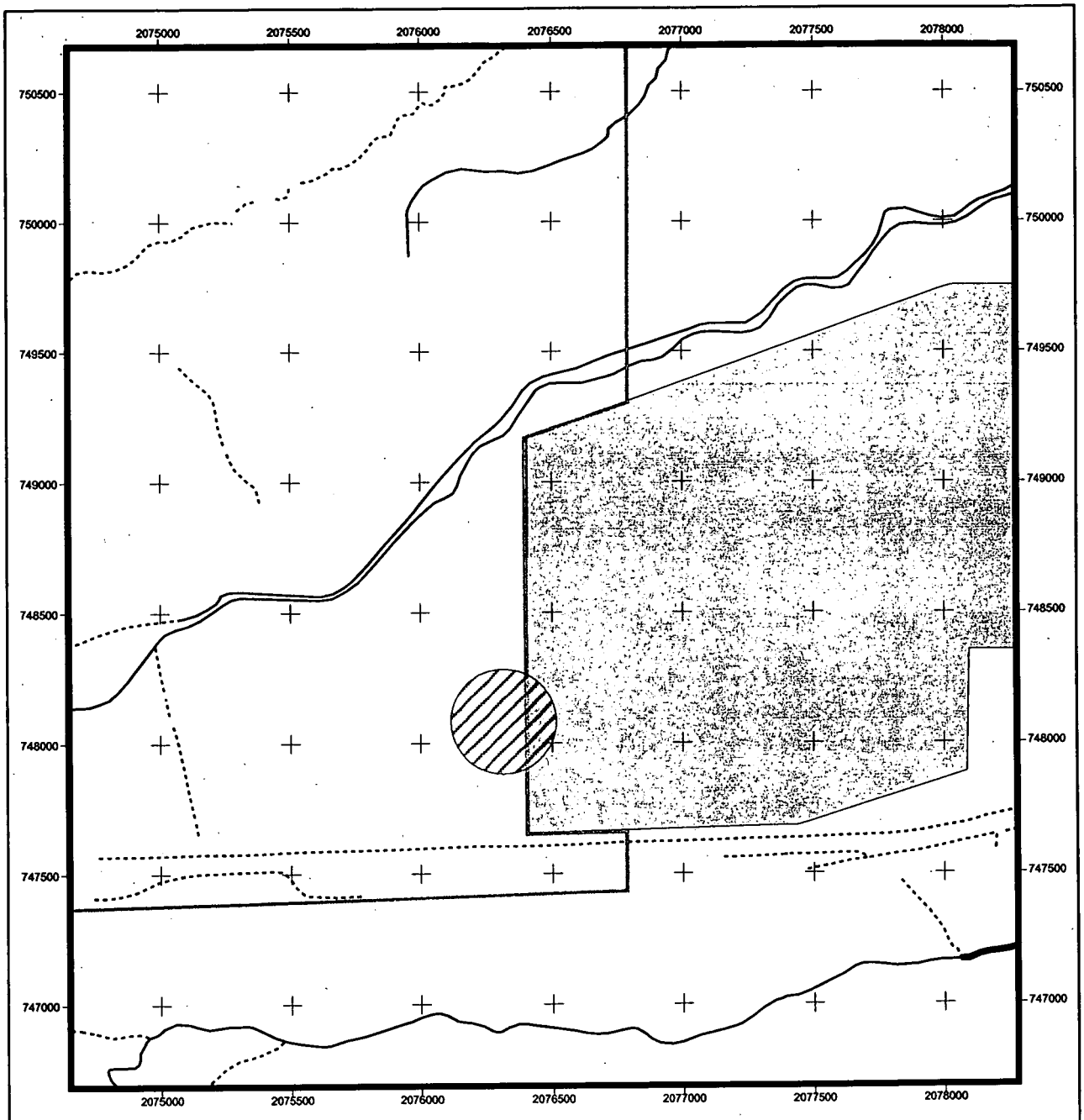

Figure A-1
Approximate Area of 1986 Buffer Zone Soil Sampling

DRAFT

KEY

- IHSS 168 (West Spray Field)
- 1986 Soil sampling area
- West Area EU

Stream

- Perennial
- Intermittent
- Ephemeral

200 0 200 Feet

Scale 1:7,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 11.10.2004

Prepared by: RADMS

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\CRA\EU_Assessments\West_Area\westeu_eu.apr

DRAFT COMPREHENSIVE RISK ASSESSMENT

VOLUME 3: APPENDIX B

Risk Assessment for the West Area Exposure Unit

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ACRONYMS

BH	Borehole
BP	Borehole product
CLP	Contract laboratory program
DER	Duplicate error ratio
DOE	Department of Energy
DQA	Data Quality Assessment
DWQPL	Dissolved water quality parameters
EPA	Environmental Protection Agency
FD	Field duplicate
GW	Groundwater
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LD	Laboratory Duplicate
LOE	Level of Effort
MS	Matrix spike
MSD	Matrix Spike Duplicate
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PRG	Preliminary Remediation Goal
QA/QC	Quality Assurance/Quality Control
QUAPP	Quality assurance project plan
RFETs	Rocky Flats Environmental Technology Site
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SED	Sediment
SOW	Statement of work
SVOC	Semivolatile organic compounds
SW	Surface water
TPU	Total propagated uncertainty
TRADS	Total radiological samples
VOC	Volatile organic compound
V&V	verification and validation
WAEU	West Area Exposure Unit
WQPL	Water quality parameter
WRW	Wildlife refuge worker

1.0 INTRODUCTION

This data quality assessment (DQA) was performed on data collected from the West Area Exposure Unit (EU) at the Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado. Samples were collected in accordance with the methodologies presented in the sampling and analysis plan (SAP) (DOE 2002). This DQA assesses the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. An analysis of method sensitivity is also included as part of this DQA. The text of this DQA will explain the quality assurance and quality control (QA/QC) requirements for each sample type and evaluate whether the requirements were met. Potential outliers will be noted and discussed. Any results that do not meet the required criteria are further evaluated and discussed in terms of their impacts on the overall utility of the data set and the project decisions for the WAEU.

Site specific QA/QC requirements are established based on a review of applicable SAPs and quality assurance project plans (QAPPs). In some cases, however, specific QA/QC requirements have not been specified in the appropriate RFETS literature. In these cases, method- and matrix-specific QA/QC requirements from the U.S. Environmental Protection Agency's (EPA's) Contract Laboratory Program (CLP) are used as default values (EPA 2003, 2004a).

2.0 PRECISION

Precision is the measurement of agreement between replicate measurements. These replicate measurements include field duplicates (FD), matrix spike duplicates (MSD), laboratory control sample duplicates (LCSD), and laboratory duplicates (LD). This DQA will assess the relative percent difference (RPD) for each of these sample types in the data set for the WAEU. RPD values are calculated using the following equation:

$$RPD = \frac{|A - B|}{(A + B)/2} \times 100$$

Where:

A = concentration in the initial sample; and

B = concentration in the duplicate.

The RPD goals are a maximum 20 percent for the groundwater and surface water samples and a maximum of 35 percent for surface soil, sediment, and subsurface soils (EPA 2004a).

Precision for radiological samples is assessed using the duplicate error ratio (DER), calculated using the following equation:

$$DER = \frac{A - B}{\sqrt{(aTPU^2 + bTPU^2)}}$$

Where:

A =	concentration in the initial sample;
B =	concentration in the duplicate;
$aTPU^2$ =	square root of the total propagated uncertainty for sample A; and
$bTPU^2$ =	square root of the total propagated uncertainty for sample B.

The counting error (2 sigma error) may be used in place of the total propagated uncertainty (TPU) value as a conservative measure.

Goals for the DER of radiological samples are less than 1.96, as defined in the Evaluation of Radiochemical Data Usability (Lockheed Martin 1997). TPU values were not provided in the database for the WAEU data set, so the counting error (2 sigma error) was used in place of the TPU in the above equation to calculate DER.

Although RPDs and DERs were calculated and compared to the control criteria for all duplicate pairs in the WAEU data set as part of this DQA, impacts to the data set based on RPD or DER exceedances were further assessed only for duplicate results that were greater than five times the method reporting limits. This "five times" rule for evaluating precision data was implemented to comply with the requirements of the CRA Methodology (DOE 2004). The magnitude of the imprecision for analytes that exceeded RPD/DER criteria was also further assessed by comparing the highest concentration values in the data set to the PRGs; if the maximum concentrations were significantly below the PRGs (e.g., five times below or more), no significant impacts were assessed to the quality of the data set and to project decision-making based on the increased imprecision associated with these analytes.

Frequency goals for MSD, LCSD, and LD pairs are 5 percent or one per laboratory batch, whichever is greater. RPD results are provided for all sample pairs collected and analyzed over the WAEU for each method and sample type: groundwater, surface water, sediment, and surface soil (Tables B1-B4). Maximum and average RPDs for each method and sample type are also provided in Tables B1 through B4. The frequency goal for collection of the FD samples is 5 percent (DOE 2002). Table B5 displays the percent of field duplicate pairs required compared with the actual collection frequencies of field duplicates achieved during the field efforts at the WAEU.

2.1 Field Duplicates

RPD and DER values for field duplicates were calculated for every target compound or analyte within each sample duplicate pair where the target compound or analyte was detected above the reporting limit in both the field sample and the corresponding field duplicate. Results of the analysis of the field duplicate RPD have been summarized by sample type and method. Tables B1 through B5 show the field duplicate pairs assessed for groundwater, surface water, sediment, and surface soil. These tables also provide the maximum and average RPD value for each method and sample type. Target compounds or analytes with RPDs outside of QC limits (greater than 20 percent for water matrices and greater than 35 percent for solid matrices) and potential impacts to data usability are discussed in the following section.

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Table B5 assesses the frequency of the field duplicate collection by sample type and test method name. No field duplicates were associated with the borehole and bore product samples contained in the data set and so were not evaluated for RPDs.

2.1.1 Groundwater Samples

Table B1 shows that three out of seven target analytes (chromium, iron, and manganese) evaluated in the total metals data set for groundwater (test method names METADD and SMETCLP) exceeded the QC limit for water of (20 percent RPD) in the single field duplicate analyzed. Likewise, 3 out of 29 target compounds from the water quality parameter data set (method WQPL) exceeded the QC limit for groundwater (Table B1). RPD values that exceeded the goal of less than 20 percent included carbonate in sample pair 52-86-10-02-87 and 52-86-10-02-87FD, total suspended solids in sample pair GW1226IT and GW1226IT, and total suspended solids in sample pair GW02796IT and GW02796IT.

A comparison of maximum detected values within the data set (Table B6) and applicable preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW) for surface water (SW) PRGs (Table B6) indicate no impact to the data sets as a result of the limited QC standards that were exceeded for metals. WRW surface water PRGs for chromium (3041.4 mg/L), iron (608.3 mg/L), and manganese (283.9 mg/L) were much greater than the highest detected values in the data set of 0.247 milligrams per liter (mg/L) for chromium, 30.4 mg/L for iron, and 1.93 mg/L for manganese (Table B6). Thus, the slightly higher magnitude of imprecision for these analytes as implied by the elevated RPDs has no effect on the project decisions. PRGs have not been developed for water quality parameters. In general, values near or below detection limits may cause relatively high RPDs, however these values rarely affect the project decisions.

The field duplicate frequency (Table B5) is adequate (greater than 5 percent) for all methods except for semivolatile organic compounds (SVOCs) (test method BNACLP), dissolved water quality parameters (test method DWQPL), total metals (test methods METADD and SMETCLP), pesticides (test method PESTCLP), and total radiological samples (test method TRADS). For total metals and total radiological samples, field duplicate frequency was only slightly below the 5 percent frequency criterion. No sample duplicates were identified for SVOCs, dissolved water quality parameters, or pesticides in the WAEU data set; however, the overall sampling frequency for these parameters was very low (10 samples or less). Moreover, water quality parameters are not used for risk-based decision making at the WAEU (no PRGs have been established), and no pesticides or SVOCs were detected in groundwater samples with the exception of low-level laboratory contaminants (phthalates). On this basis, the deficiencies identified in field duplicate frequency do not appear to affect the overall quality of the WAEU data set or the project decisions.

2.1.2 Surface Water Samples

The following target analytes exceeded the precision goal of 20 percent or the DER goal of 1.96.:

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- A total of 5 out of 53 target analytes for dissolved metals analysis (methods DMETADD and DSMETCLP), including barium, copper, and iron, potassium, and zinc (Table B2).
- A total of 17 out of 71 target analytes for total metals analysis (methods METADD, METCLP, SMETCLP) exceeded the RPD goal of 20 percent (Table B2), including silicon in two duplicate pairs, aluminum in three duplicate pairs, iron in four duplicate pairs, lead, manganese in three duplicate pairs, sodium, and zinc in three duplicate pairs.
- One out of 11 duplicate pairs for radiological analyses, gross alpha (method TRADS), exceeded the DER goal of 1.96 (Table B2). The remaining duplicate pairs for TRAD analysis were below the DER goal of 1.96. The result should not affect data usability because the analysis of gross alpha is used as a screening tool and PRGs for gross alpha have not been developed.
- A total of 7 out of 38 target compounds for water quality parameters (method WQPL) exceeded the RPD goal of 20 percent (Table B2), including sulfate in two duplicate pairs, total dissolved solids in one duplicate pair, and total suspended solids in four duplicate pairs exceeded the RPD goal of 20 percent.

Data usability was not altered by these values that exceeded the RPD goal. Table B6 provides a list of all duplicate pairs where the RPD was exceeded, along with the applicable PRGs. As was noted for the groundwater samples, the highest detected values for all target analytes and compounds with elevated RPDs in the surface water data set are well below applicable PRGs. On this basis, the somewhat increased imprecision implied for the analytes with RPD/DER exceedances appears to have no significant impacts on data usability and decision-making for the surface water data set.

The field duplicate frequency (Table B5) is adequate (greater than 5 percent) for all surface water methods; therefore, the field duplicate frequency obtained is adequate for the WAEU surface water data set.

2.1.3 Sediment Samples

Twelve out of 33 duplicate pairs evaluated exceeded the RPD goal of 35 percent for total metals (SMETCLP) in sediment samples (Table B3). One duplicate pair each for aluminum, chromium, copper, and iron, as well as two duplicate pairs each for lead, manganese, vanadium, and zinc, exceeded the 35 percent RPD goal.

Four out of 12 duplicate pairs for radiological analysis (TRADS) exceeded the DER goal of 1.96. One duplicate pair each for plutonium-239/240, strontium-90, uranium-234, and uranium-238 exceeded the DER goal of 1.96.

Data usability was not affected by these results. Table B6 provides a list of all duplicate pairs where the RPD was exceeded, the highest detected result for each compound, and applicable PRGs. The highest detected values for all target analytes and compounds in the data set are well below applicable PRGs for sediment, indicating that QC standards that were exceeded for duplicate RPDs will not affect data usability.

The field duplicate frequency (Table B5) exceeded the frequency goal of 5 percent for all methods used to analyze sediment samples in the WAEU data set.

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2.1.4 Surface Soil Samples

Four out of 22 duplicate pairs for total metals in surface soil exceeded the RPD goal of 35 percent. One duplicate pair each for lead, cobalt, copper, and calcium exceeded the 35 percent RPD goal.

Data usability was not affected by these RPD goals that were exceeded. Table B6 lists all duplicate pairs where the RPD goal was exceeded and the applicable PRGs. The highest detected values for all target analytes and compounds in the data set are well below applicable PRGs for surface soil, indicating that QC values that were exceeded for duplicate RPDs will not affect data usability.

The field duplicate frequency (Table B5) exceeded the frequency goal of 5 percent for all methods except gamma spectroscopy (TRADS). Only one sample of surface soil was analyzed by gamma spectroscopy in the WAEU data set. Frequency goals were met for the remaining alpha spectrometry and total metals analyses used to analyze sediment samples in the WAEU data set.

2.2 Matrix Spike Duplicates

The precision for the matrix spike duplicates is measured by calculating the RPD for the matrix spike (MS) and its corresponding MSD. In accordance with CLP guidelines (EPA 2003), the RPD is calculated using the percent recoveries of the spikes and not the actual spike concentrations. MS/MSD pair RPDs were calculated for each method and sample type (Table B7). Table B8 lists the minimum, maximum, and average RPD values for each spiked compound sorted by method and sample type. MS/MSD pairs are collected for analysis of organic compounds only.

A review of Table B7 shows that all spiked compounds in MS/MSD pairs for water and soil were below the RPD goals of 20 percent (water) and 35 percent (soil). The MS/MSD review indicates that data quality for the WAEU data set is not affected by RPD analysis of MS/MSD pairs.

The frequency of MS/MSD analysis is provided in Table B8. Deficiencies in matrix spike frequencies were encountered in the WAEU data set. The frequency requirement of 5 percent was not met for the following methods and sample types:

- SVOCs in groundwater (BNACLP/ GW)
- All water quality parameters in surface water (DWQPL/SW, E130.2SM2340C/SW, E300.0/SW, E375.1/SW, E600/SW, IONS/SW, and WQPL/SW), and water quality parameters in borehole and borehole product samples (WQPL/BH/BP)
- Water quality parameters in groundwater (WQPL/GW)
- Water quality parameters in sediment (WQPL/SED)
- Pesticides in groundwater (PESTCLP/GW)
- Pesticides in surface water (PESTCLP/SW)
- Volatile organic compounds (VOCs) in drinking water (EPA 524.2/GW)

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- VOCs in borehole and borehole product samples (VOACLP/BH/BP).

Fourteen out of a possible 21 method and sample type combinations was 0 percent (Table B7). MS/MSD sampling frequencies were deficient for 68 percent of the organic method/sample type combinations collected under the WAEU data set. Although 68 percent of the MS/MSD sampling frequencies were found to be deficient, PRGs have only been specified for pesticide, SVOCs, and volatile organic compounds (VOCs) in the above list. If target analytes for compounds contained in these three analytical method groups do not approach or exceed applicable PRGs, it is unlikely that the deficiencies in MS/MSD frequency will affect data quality or decision making for the EU.

2.3 Laboratory Control Sample Duplicates

The precision for the laboratory control sample duplicates is measured by calculating the RPD for the laboratory control sample (LCS) and LCSD. In accordance with CLP guidelines (EPA 2003), the RPD is calculated using the percent recoveries of the spikes and not the actual spike concentrations. Multiple queries of the WAEU data set found no results for LCSD samples. Therefore, precision using LCS/LCSD sample pairs was not evaluated for this DQA.

2.3.1 Laboratory Duplicates

Precision is evaluated for the laboratory duplicates in the same manner as for field duplicates, except that the duplicate sample is not collected in the field, but rather is a duplicate aliquot (of the same sample) carried throughout the entire analytical procedure and analyzed in the laboratory. Laboratory duplicates are analyzed for inorganic and radiological methods only and are used to assess precision in the same manner as MS/MSD sample pairs in organic analyses.

Although additional laboratory duplicates may have been analyzed, multiple database queries yielded only five laboratory duplicate analyses where the analyte was detected in both the original sample and the duplicate. Of these five sample pairs, only the result for chromium exceeded the RPD goal of 20 percent for water (Table B9). The DER values for all laboratory duplicates for uranium-234 and uranium-238 were below the upper limit of 1.96.

Table B10 lists the frequency of laboratory duplicate sample analyses achieved in the WAEU data set. Only 2 of the 29 laboratory duplicate pairs — alpha spectroscopy in surface soil (ALPHASPEC/SS) and total metals in surface water (CLP-SOW-TOTAL/SW) — exceeded the 5 percent laboratory duplicate goal.

3.0 ACCURACY

Accuracy is the closeness of a measurement to the true value. Accuracy is measured by the percent recovery of target analytes or similar chemicals to the known value of a spiked sample or standard. The quality control parameters used for accuracy are matrix spike recoveries, laboratory control sample recoveries, and surrogate recoveries. The percent recoveries are calculated using the following formula.

$$\%R = \frac{F}{T} \times 100$$

Where:

F is the analytical result and T is the true value of the spiking compound. The percent recovery requirements used for this assessment are the values from the CLP SOW (EPA 2004). Results for the surrogates with unknown names were not assessed. Tables B42-B46 show he highest detected results for each sample type compared to their associated PRGs.

3.1 Matrix Spikes

The accuracy of the MS samples is measured by the percent recovery. The recoveries were evaluated primarily based on the minimum recovery, because recoveries above the QC limits indicate high or conservative bias. The minimum, maximum, and average percent recoveries for the matrix spike for all sample type are shown in Tables B-11 through B-15. The frequency of the spiked samples was also evaluated against the requirement of 5 percent. The number and frequency of the matrix spikes for each method and matrix are shown in Table B-16.

3.1.1 Groundwater Samples

Arsenic, iron and manganese had low recoveries for the matrix spike (less than 75%). The highest results for arsenic and iron were significantly below the PRGs and there were no detections for manganese in the groundwater samples. One recovery was negative. This value was not considered, however, since the concentration of the original result was probably large enough to mask the spiking concentration. Results for all other analytes were within the QC limits.

The frequency requirement for the matrix spikes in groundwater was met, with the exception of a few methods. No matrix spike samples were analyzed using the radiological (DRADS and TRADS) and the total metals (METCLP) methods. Matrix spikes are not normally analyzed for radiological samples, and only two samples were analyzed using the METCLP method. Overall, the matrix spikes were analyzed at an adequate frequency. The findings from the assessment of the matrix spike recoveries for groundwater did not affect the project decisions.

3.1.2 Surface Water Samples

Results for 5 out of 23 metals were below the quality control limit of 75 percent. These metals were aluminum, arsenic, antimony, iron, and selenium. The low recovery implies that the results were biased low. The highest detection of each of these compounds was significantly below the PRG, however.

The lowest recovery for chloride was below the QC limits of 75%. However, there were no PRGs or associated decision impacts for water quality parameters. The result for 1,1-dichloroethene was also below the quality control limits; however, there were no detected results for this compound, and the reporting limit was significantly below the PRG.

The frequency for the matrix spikes in surface water was met, with the exception of a few methods. The frequency for metals analyzed using dissolved and total metals

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(DMETADD and METADD) was 3.85 percent; the frequency for radiological analysis DRADs was 4.4 percent; and the frequency from total metals (SMETCLP) was 4.35 percent. These values are only slightly below the required frequency and moreover matrix spikes are not generally required for radiological samples. No matrix spike samples were analyzed using methods pesticides (PESTCLP). Overall, the matrix spikes were analyzed at an adequate frequency. The surface water matrix spike recoveries did not affect the project decisions.

3.1.3 Sediment Samples

Recoveries for antimony and selenium were below the QC limits. The recovery for nitrate/nitrite was also below the QC limit. Again, the highest detection for these analytes was significantly below the PRG, however. The frequency for the matrix spikes in sediment samples was met, with the exception of a few methods. No matrix spike samples were analyzed using methods DMETADD, DRADS, and TRADS, however, matrix spikes are not normally analyzed for radiological samples. Only two samples were analyzed using the DMETADD method. Overall, the matrix spikes were analyzed at an adequate frequency. The assessment of the sediment matrix spike recoveries did not affect the project decisions.

3.1.4 Surface Soil Samples

Recoveries for antimony, iron, and silica were below the QC limits. The highest detections for antimony were significantly below the PRG. There were no detections for silica in the sediment samples. The highest result for iron was 16,000 milligrams per kilogram (mg/kg); the PRG is 33,326 mg/kg, and the minimum recovery was 35 percent. Further review of the data indicated that this low recovery was not within the same sample batch as the maximum detection. Rather, the low recovery was associated with a batch containing only one soil sample (that was also used as the matrix spike sample) with a concentration of 12,000 mg/kg. Because the observed recovery may have been impacted by the high native concentration of iron in the sample, no impacts to the data set were assessed for decision-making purposes. The frequency of the matrix spike was met for the analysis of surface soil.

3.1.5 Borehole Samples

Of all analytes, recoveries only for chromium, manganese, and selenium were below the QC limits. The highest detections of these analytes were significantly below the PRGs. The frequency for the matrix spikes in the borehole samples was met, with one exception. Overall, the matrix spikes were analyzed at an adequate frequency. The assessment of the bore samples did not affect the project decisions.

3.2 Matrix Spike Duplicates

Similar to the MS samples, the accuracy of the MSD samples is measured by the percent recovery. MSDs are required only in the analysis of organic compounds. The recoveries are evaluated using the minimum recovery, as the high recoveries indicate a high bias. The frequency of the spiked samples was also evaluated against the requirement of 5 percent. The discussion of the frequency of the matrix spike duplicate is the same as in the previous sections. The minimum, maximum, and average percent recoveries in the matrix spike duplicates for all sample types are shown in Tables B-17 through B-20. The

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frequency of the matrix spike duplicates is shown in Table B-16. Because no organic analyses were performed for surface soil samples at the WAEU, no MSDs were required for this matrix.

3.2.1 Groundwater Samples

The range of MSD recoveries for the groundwater samples was 64 to 129 percent. The recoveries are within the required quality control limits. The range of the average recoveries was 93 to 99 percent. Since the recoveries were within the quality control limits, no further comparison with the PRGs is necessary. The assessment of the data for groundwater samples had no effect on the project decisions.

3.2.2 Surface Water Samples

The range of percent recoveries for the surface water samples was 51 to 121 percent. The range for the average recoveries was 83 to 113 percent. The recovery of 1,1-dichloroethene was below the QC limits. However, the analyte was not detected in the surface water samples, and the reporting limit is significantly below the PRG. The detection limit was significantly below the PRG. All other recoveries were within the quality control limits, and no further comparison to the PRGs is necessary. The assessment of the data for surface water samples had no effect on project decisions.

3.2.3 Sediment Samples

The range of recoveries for the sediment samples was 42 to 160 percent. The range of the average recoveries was 60 to 123 percent. None of the analytes that had recoveries below the quality control limits were detected in the sediment samples. The reporting limits were significantly below the PRG. No further comparison to the PRGs is necessary as a result. The assessment of the data for sediment samples had no effect on the project decisions.

3.2.4 Borehole Samples

The percent recoveries for the one sample analyzed for the matrix spike duplicate were all within the quality control limits. No further comparison to the PRGs is necessary as a result. This sample is not included in the risk assessment and will not be evaluated

3.2.5 Laboratory Control Samples

The accuracy of the LCS samples is measured by the percent recovery. Only samples with a result code of LCS were selected for this DQA. The recoveries were evaluated using the minimum recovery. The LCS minimum and average percent recoveries for the WAEU are shown in Table B-21. The LCS samples were not identified by sample type (groundwater, surface water, etc), therefore the recoveries presented are for all sample types combined for a given method name. LCSs are generally not required for organics parameters analyzed by CLP multi-concentration methods, or for radiochemistry methods. For other methods, an LCS should generally be associated with every laboratory batch. For each method to which LCS analyses apply, Table B22 shows how many of the total analytical batches analyzed have associated LCS. As shown, LCS could not be found for many of the metals methods. Unless LCS data for these methods can be found and assessed, the evaluation of accuracy for metals can be based only on MS results.

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The range of the percent recoveries for the LCS samples found in the WAEU data set was 80 to 117 percent. These recoveries are all within the quality control limit requirements. No further comparison to the PRGs is necessary as a result. The LCS percent recoveries had no effect on the project decisions.

3.2.6 Surrogate Recovery

Surrogates are used in SVOC, pesticide, and VOC analysis to assess the efficiency of the extraction process. The surrogate recoveries were evaluated by sample type and method. Only the minimum recovery was assessed. Surrogate values above the QC requirements indicate high bias. Surrogates should be included in every analysis. Several samples for this data set did not have surrogate recoveries. It is probable that the surrogate data were not included in the electronic deliverable for all samples. The review of hard-copy data verified that surrogates were added to a small percentage of the samples, 1 percent. The data were properly qualified because of surrogate recovery problems and are discussed in the verification and validation (V&V) assessment. The number of samples that do not have surrogates are shown in Table B-23. Tables B-24 though B-27 show the minimum, maximum, and average surrogate recoveries for each sample type.

The minimum surrogate recoveries for deuterated, 2-dichloroethene and bromofluorobenzene for the methods used to analyze volatile compounds in groundwater (VOA524.2 and VOACLP) were below the QC limits. According to the EPA functional guidelines, only recoveries of less than 10 percent have an impact on the usability of the data. The recoveries were above 10 percent and had no impact on the project decisions.

The minimum surrogate recoveries for 2,4,6-tribromophenol for the semivolatile (BNACLP) analysis and for bromofluorobenzene in the volatile analysis (VOA524.2) were below the QC limits. According to the EPA functional guidelines, only recoveries of less than 10 percent have an impact on the usability of the data. The recoveries were above 10 percent and therefore had no impact on the project decisions. The assessment of the surrogates had no effect on project decisions.

4.0 REPRESENTIVENESS

Representativeness is a measure of the degree to which data collected represent the extent of the contamination at the WAEU. In this data set, 273 samples were collected for analysis by various methods. The preceding discussions in this DQA noted only minor exceedances of control criteria that generally did not appear to affect the data utility for the WAEU. These control criteria encompassed a broad range of field and laboratory QC checks for both precision and accuracy. Evaluations of QC blank samples also found no significant impacts to the data set from blank artifacts or cross contamination (see the Sensitivity discussion below). On this basis, the WAEU data set appears to be of sufficient representativeness to support the project decisions.

5.0 COMPARABILITY

Comparability is the measure of the ability of the different laboratories to report similar data. This ability is promoted by use of promulgated methods and standard laboratory practices. This data set was collected over a long time, and several laboratories were

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involved with various analytical and reporting requirements. However, the variations in data quality and usability appear to be minor because the methodologies remained fairly consistent. Overall, the analytical data collection approach conducted by RFETS over time has relied on standard, well-documented methods established by EPA under the CLP program, plus other proven techniques and promulgated methods from EPA (waste water, drinking water, and solid waste methods) and other sources. In the electronic data, comparability is indicated by consistency in reporting units, reporting limits, QC criteria, and data format. Any minor differences in these data have been addressed by normalization protocols during data validation, verification, and reduction.

6.0 COMPLETENESS

Project completeness in accordance with the requirements of the CRA Methodology (DOE 2004) is discussed in Section 1.3 of this CRA (Data Adequacy). On a strictly analytical basis, completeness can be further evaluated as the measure of the number of valid data points compared with the planned data points. The sample locations and analysis from the sampling plan is compared with the actual sample collected and the analysis performed. Tables B-28 through B-32 describe the number of analysis from each method, the associated qualifiers, and the percent of data qualified. Completeness is calculated for each target parameter as the ratio of the actual valid data points (data points that have not been rejected after analysis or validation) to the planned data points. Although rejected results must be removed from the data set, other qualified data (such as estimated data) are considered usable and can be included in the data set to calculate completeness. For this dataset, 3.5 percent of the data were rejected, which yields a completeness value of 96.5 percent

7.0 SENSITIVITY

7.1 Field Blanks

The field blanks are used to identify possible contamination from other sources during the sampling event. The field blank is collected while sampling is taking place and is used to detect any ambient contamination. Water is allowed to sit near the sampling location for the entire day and the field blank is collected from the water. Field blanks are collected at a frequency of once per day or 5 percent of the total real samples. The equipment rinsate is used to evaluate the adequacy of the decontamination procedures. Water is rinsed over the sampling equipment after the decontamination procedure and is collected as the equipment rinsate. The equipment rinsate is collected once daily after decontamination procedures have been completed or at 5 percent of the total number of real samples. Any detections in the field blank or the equipment rinsates should be less than one-tenth the PRG. Table B-33 shows the contamination found in the field blanks. No contamination above one-tenth the PRG was found, except for one detected concentration of uranium-238.

The uranium-238 detected in an equipment rinsate required secondary analysis. Using the laboratory batch identification number, two samples were associated with the equipment rinsate that required secondary analysis. The results for uranium-234 in both samples were well below the PRG. The results were also rejected. A reason code had

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not been assigned to explain the "rejected" qualifiers, however. These results will not be included in the assessment of this data set, so there is no effect on the project decisions.

7.2 Trip Blanks

Trip blanks accompany all VOA sample containers from the laboratory to the sampling event and back to the laboratory. Trip blanks are used to evaluate whether any contamination may be introduced to a sample during the shipping process. Table B-34 shows detected compounds from various trip blanks in the WAEU data set. Table B-35 shows the number of trip blanks per VOA sample. None of the detected compounds found in the trip blanks was above one-tenth of the applicable PRG. An assessment of the trip blanks indicates no effect on the project decisions.

7.3 Method Blanks

Method or "prep" blanks are prepared at the laboratory to evaluate possible contamination during the extraction and analysis process. The method blank is prepared with contaminant–free water and extracted and analyzed along with "real" samples. A method blank is included in every batch. Table B-36 shows the method blank contamination, and Table B-23 shows the number of batches and the number of batches with method blanks. None of the detected results in the method blanks was greater than one-tenth the PRGs. The assessment of the method blanks had no effect on the project decisions.

7.3.1 Sensitivity/Reporting Limits

The detection limit is the limit where the analyte can be detected above instrument background noise. The detection limit is statistically derived by analyzing a set of standards near the lowest standard concentration. The reporting limit is generally established as a limit of quantitation at a level above the statistical detection limit, and is set by either the EPA CLP statement of work (SOW) or by the laboratory. Normally, the reporting limit is 5 to 10 times the detection limit. Reporting of method sensitivity information for this project varied: detection limits were reported for some target parameters whereas reporting limits were reported for others. The maximum non-detect value reported for a given analyte, whether a detection limit or a reporting limit, was compared to method requirements to assess whether project sensitivity objectives had been attained. For the WAEU, the maximum reported limit met the method requirements for the analytes of concern. The maximum detection/reporting limits are shown in Tables B-37-43. The assessment of the detection and reporting limits had no effect on the project decision.

8.0 REFERENCES

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Table B1
Groundwater Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD/D	Maximum RPD/DER	
GW	5186	GW02796IT	GW02796IT	DMETADD	Silicon	9730	9800	100	ug/L	1	1	1
GW	1081	10-81-07-10-89FD	10-81-07-10-89	DRADS	Gross Beta	4.3	1		pCi/L	1.01	1.67	0.80
GW	1081	10-81-07-10-89FD	10-81-07-10-89	DRADS	Plutonium-239/240	0.007	0.01		pCi/L	0.48		
GW	1081	10-81-07-10-89FD	10-81-07-10-89	DRADS	Uranium-235	0.18	0.2		pCi/L	0.06		
GW	1081	10-81-07-10-89FD	10-81-07-10-89	DRADS	Uranium-238	0.09	-0.07		pCi/L	1.67		
GW	1081	GW00801IT	GW00801IT	DSMETCLP	Calcium	16800	16400	5	ug/L	2	6	2
GW	1081	GW01226IT	GW01226IT	DSMETCLP	Calcium	16500	16700	5	ug/L	1		
GW	5186	GW02796IT	GW02796IT	DSMETCLP	Calcium	15200	15500	5	ug/L	2		
GW	1081	GW00801IT	GW00801IT	DSMETCLP	Sodium	11500	10800	5	ug/L	6		
GW	1081	GW01226IT	GW01226IT	DSMETCLP	Sodium	11300	11400	5	ug/L	1		
GW	5186	GW02796IT	GW02796IT	DSMETCLP	Sodium	9910	9940	5	ug/L	0		
GW	5186	GW02796IT	GW02796IT	METADD	Silicon	12400	12700	100	ug/L	2	64	23
GW	5186	GW02796IT	GW02796IT	SMETCLP	Aluminum	1250	1320	200	ug/L	5		
GW	5186	GW02796IT	GW02796IT	SMETCLP	Calcium	16300	17000	5	ug/L	4		
GW	5186	GW02796IT	GW02796IT	SMETCLP	Chromium	12.8	24.8	10	ug/L	64		
GW	5186	GW02796IT	GW02796IT	SMETCLP	Iron	1880	2760	100	ug/L	38		
GW	5186	GW02796IT	GW02796IT	SMETCLP	Manganese	30.2	48.6	15	ug/L	47		
GW	5186	GW02796IT	GW02796IT	SMETCLP	Sodium	9730	10100	5	ug/L	4		
GW	1081	10-81-08-21-87FD	10-81-08-21-87	WQPL	Bicarbonate As CaCO3	40	39	1	mg/L	3	128	13
GW	5286	52-86-10-02-87FD	52-86-10-02-87	WQPL	Bicarbonate As CaCO3	23.4	28.4		mg/L	19		
GW	1081	GW00801IT	GW00801IT	WQPL	Bicarbonate As CaCO3	36	38	1	mg/L	5		
GW	1081	GW01226IT	GW01226IT	WQPL	Bicarbonate As CaCO3	35	36	1	mg/L	3		
GW	5186	GW02796IT	GW02796IT	WQPL	Bicarbonate As CaCO3	24	27	1	mg/L	12		
GW	5286	52-86-10-02-87FD	52-86-10-02-87	WQPL	Carbonate As CaCO3	18.5	13.4		mg/L	32		
GW	1081	10-81-08-21-87FD	10-81-08-21-87	WQPL	Chloride	3.76	3.79	1	mg/L	1		
GW	5286	52-86-10-02-87FD	52-86-10-02-87	WQPL	Chloride	1.3	1.3		mg/L	0		
GW	1081	GW00801IT	GW00801IT	WQPL	Chloride	5.5	5.8	0.2	mg/L	5		
GW	1081	GW01226IT	GW01226IT	WQPL	Chloride	5.6	6	0.2	mg/L	7		

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Table B1
Groundwater Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD/DER	Maximum RPD/DER	Average RPD/DER
GW	5186	GW02796IT	GW02796IT	WQPL	Chloride	5	5	0.2	mg/L	0	128	12
GW	1081	10-81-08-21-87FD	10-81-08-21-87	WQPL	Nitrate	7.85	7.65		mg/L	3		
GW	1081	10-81-08-21-87FD	10-81-08-21-87	WQPL	Nitrate/Nitrite	7.85	7.65		mg/L	3		
GW	1081	GW00801IT	GW00801IT	WQPL	Silica	11	12	0.4	mg/L	9		
GW	1081	GW01226IT	GW01226IT	WQPL	Silica	11	10	0.4	mg/L	10		
GW	1081	10-81-08-21-87FD	10-81-08-21-87	WQPL	Sulfate	18	21	1	mg/L	15		
GW	5286	52-86-10-02-87FD	52-86-10-02-87	WQPL	Sulfate	57.3	55		mg/L	4		
GW	1081	GW00801IT	GW00801IT	WQPL	Sulfate	19	17	2	mg/L	11		
GW	1081	GW01226IT	GW01226IT	WQPL	Sulfate	19	20	2	mg/L	5		
GW	5186	GW02796IT	GW02796IT	WQPL	Sulfate	30	30	2	mg/L	0		
GW	1081	10-81-08-21-87FD	10-81-08-21-87	WQPL	Total Dissolved Solids	138	163	1	mg/L	17		
GW	1081	GW00801IT	GW00801IT	WQPL	Total Dissolved Solids	140	130	10	mg/L	7		
GW	1081	GW01226IT	GW01226IT	WQPL	Total Dissolved Solids	110	130	10	mg/L	17		
GW	5186	GW02796IT	GW02796IT	WQPL	Total Dissolved Solids	120	130	10	mg/L	8		
GW	1081	GW00801IT	GW00801IT	WQPL	Total Suspended Solids	13	14	4	mg/L	7		
GW	1081	GW01226IT	GW01226IT	WQPL	Total Suspended Solids	50	11	4	mg/L	128		
GW	5186	GW02796IT	GW02796IT	WQPL	Total Suspended Solids	87	68	4	mg/L	25		

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Surface Water Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Average RPD
SW	SW006	SW00980WC	SW00980WC	DMETADD	Silicon	618	657	14.2	mg/L	6	80	8
SW	SW007	SW01081WC	SW01081WC	DMETADD	Silicon	3430	3710	10	ug/L	8		
SW	SW006	SW02028WC	SW02028WC	DMETADD	Silicon	1420	1580	15.2	ug/L	11		
SW	SW006	SW00980WC	SW00980WC	DMETADD	Strontium	134	136	7.3	ug/L	1		
SW	SW007	SW01081WC	SW01081WC	DMETADD	Strontium	172	172	10	ug/L	0		
SW	SW006	SW02028WC	SW02028WC	DMETADD	Strontium	120	108	8	ug/L	11		
SW	SW006	SW01937WC	SW01937WC	DMETCLP	Calcium	24600	25300	5	ug/L	3		
SW	SW006	SW02022WC	SW02022WC	DMETCLP	Calcium	10500	11200	5	ug/L	6		
SW	SW006	SW01937WC	SW01937WC	DMETCLP	Iron	192	194	100	ug/L	1		
SW	SW006	SW01937WC	SW01937WC	DMETCLP	Magnesium	7220	7420	5	ug/L	3		
SW	SW006	SW01937WC	SW01937WC	DMETCLP	Manganese	28	28	1.5	ug/L	0		
SW	SW006	SW01937WC	SW01937WC	DMETCLP	Silicon	879	871	100	ug/L	1		
SW	SW006	SW02022WC	SW02022WC	DMETCLP	Silicon	3480	3420	100	ug/L	2		
SW	SW006	SW01937WC	SW01937WC	DMETCLP	Sodium	30000	30800	5	ug/L	3		
SW	SW006	SW02022WC	SW02022WC	DMETCLP	Sodium	12800	13600	5	ug/L	6		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Barium	45.2	59.1	4.4	ug/L	27		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Barium	63.9	67.8	20	ug/L	6		
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Barium	40.9	40.4	20	ug/L	1		
SW	SW006	SW006005D	SW006005	DSMETCLP	Calcium	18600	18300	5	ug/L	2		
SW	SW006	SW006008D	SW006008	DSMETCLP	Calcium	11700	11300	100	ug/L	3		
SW	SW006	SW00690001	SW00690001	DSMETCLP	Calcium	13600	14200		ug/L	4		
SW	SW006	SW00690003	SW00690003	DSMETCLP	Calcium	20100	19500		ug/L	3		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Calcium	20700	20800	14.3	ug/L	0		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Calcium	25800	26200	100	ug/L	2		
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Calcium	17100	16600	17.4	ug/L	3		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Copper	3	7	2.5	ug/L	80		
SW	SW006	SW006008D	SW006008	DSMETCLP	Iron	261	251	30	ug/L	4		
SW	SW006	SW00690001	SW00690001	DSMETCLP	Iron	154	196		ug/L	24		
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Iron	118	167	4.7	ug/L	34		
SW	SW006	SW00690003	SW00690003	DSMETCLP	Magnesium	5700	5540		ug/L	3		
SW	SW006	SW00690003D	SW00690003D	DSMETCLP	Magnesium	5700	5540		ug/L	3		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Magnesium	6600	6570	35.9	ug/L	0		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Magnesium	5560	5630	1	ug/L	1		
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Magnesium	5080	4900	29.6	ug/L	4		
SW	SW006	SW006005D	SW006005	DSMETCLP	Manganese	41.6	40.9	15	ug/L	2		
SW	SW006	SW00690001	SW00690001	DSMETCLP	Manganese	94.9	96.6		ug/L	2		
SW	SW006	SW00690003D	SW00690003D	DSMETCLP	Manganese	75.4	74.5		ug/L	1		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Manganese	11.6	14	1	ug/L	19		
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Manganese	33.3	33.1	2.1	ug/L	1		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Potassium	2120	2090	94.8	ug/L	1		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Potassium	3410	2510	10	ug/L	30		

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Surface Water Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Average RPD
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Potassium	4080	3820	77.9	ug/L	7		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Silicon	3430	3710	10	ug/L	8		
SW	SW006	SW006005D	SW006005	DSMETCLP	Sodium	23500	21100	5	ug/L	11		
SW	SW006	SW006008D	SW006008	DSMETCLP	Sodium	16200	15400	50	ug/L	5		
SW	SW006	SW00690001D	SW00690001D	DSMETCLP	Sodium	16400	15900		ug/L	3		
SW	SW006	SW00690003D	SW00690003D	DSMETCLP	Sodium	22600	22600		ug/L	0		
SW	SW006	SW00980WC	SW00980WC	DSMETCLP	Sodium	30800	30200	21.4	ug/L	2		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Sodium	44800	44600	10	ug/L	0		
SW	SW006	SW02028WC	SW02028WC	DSMETCLP	Sodium	24000	23200	28.3	ug/L	3		
SW	SW007	SW01081WC	SW01081WC	DSMETCLP	Strontium	172	172	10	ug/L	0		
SW	SW006	SW00690001D	SW00690001D	DSMETCLP	Zinc	113	110		ug/L	3		
SW	SW006	SW00690003	SW00690003	DSMETCLP	Zinc	23.7	35.3		ug/L	39		
SW	SW006	SW00980WC	SW00980WC	METADD	Lithium	2.1	2.1	2	ug/L	0	144	17
SW	SW006	SW00980WC	SW00980WC	METADD	Silicon	917	1770	14.2	ug/L	63		
SW	SW007	SW01081WC	SW01081WC	METADD	Silicon	4010	3820	10	ug/L	5		
SW	SW006	SW02028WC	SW02028WC	METADD	Silicon	1610	1610	15.2	ug/L	0		
SW	SW006	SW00980WC	SW00980WC	METADD	Strontium	143	150	7.3	ug/L	5		
SW	SW007	SW01081WC	SW01081WC	METADD	Strontium	170	170	10	ug/L	0		
SW	SW006	SW02028WC	SW02028WC	METADD	Strontium	121	120	8	ug/L	1		
SW	SW007	SW01081WC	SW01081WC	METADD	Tin	14.8	14.8	10	ug/L	0		
SW	SW006	SW02022WC	SW02022WC	METCLP	Calcium	10700	10500	5	ug/L	2		
SW	SW006	SW01937WC	SW01937WC	METCLP	Silicon	200	1180	100	ug/L	142		
SW	SW006	SW02022WC	SW02022WC	METCLP	Silicon	3910	3910	100	ug/L	0		
SW	SW006	SW02022WC	SW02022WC	METCLP	Sodium	12700	12900	5	ug/L	2		
SW	SW006	SW006005D	SW006005	SMETCLP	Aluminum	2960	2390	0.2	ug/L	21		
SW	SW006	SW00690001D	SW00690001D	SMETCLP	Aluminum	2060	2090		ug/L	1		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Aluminum	368	108	10	ug/L	109		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Aluminum	69.4	111	18.7	ug/L	46		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Barium	55.3	64.7	4.4	ug/L	16		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Barium	83.5	71.2	0.02	ug/L	16		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Barium	42.3	42.8	2.1	ug/L	1		
SW	SW006	SW006005D	SW006005	SMETCLP	Calcium	19500	19000	5	ug/L	3		
SW	SW006	SW006006D	SW006006	SMETCLP	Calcium	15600	15200	5	ug/L	3		
SW	SW006	SW006008D	SW006008	SMETCLP	Calcium	12000	11900	0.1	ug/L	1		
SW	SW006	SW00690001D	SW00690001D	SMETCLP	Calcium	14700	14100		ug/L	4		
SW	SW006	SW00690003D	SW00690003D	SMETCLP	Calcium	18700	19200		ug/L	3		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Calcium	21900	22700	14.3	ug/L	4		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Calcium	25500	26600	100	ug/L	4		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Calcium	17500	17100	17.4	ug/L	2		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Copper	5.7	6.5	2.5	ug/L	13		

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Surface Water Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Average RPD
SW	SW006	SW006005D	SW006005	SMETCLP	Iron	7090	3360	100	ug/L	71		
SW	SW006	SW006006D	SW006006	SMETCLP	Iron	484	465	100	ug/L	4		
SW	SW006	SW006007D	SW006007	SMETCLP	Iron	595	594	30	ug/L	0		
SW	SW006	SW006008D	SW006008	SMETCLP	Iron	488	578	30	ug/L	17		
SW	SW006	SW00690001D	SW00690001D	SMETCLP	Iron	2120	2080		ug/L	2		
SW	SW006	SW00690003D	SW00690003D	SMETCLP	Iron	1380	1430		ug/L	4		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Iron	984	1750	4.3	ug/L	56		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Iron	504	82.3	5	ug/L	144		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Iron	327	405	4.7	ug/L	21		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Lead	1.9	2.8	1.4	ug/L	38		
SW	SW006	SW006005D	SW006005	SMETCLP	Magnesium	5330	5210	5	ug/L	2		
SW	SW006	SW006006D	SW006006	SMETCLP	Magnesium	5250	5120	5	ug/L	3		
SW	SW006	SW00690003D	SW00690003D	SMETCLP	Magnesium	5220	5370		ug/L	3		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Magnesium	7030	7260	35.9	ug/L	3		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Magnesium	5650	5690	1	ug/L	1		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Magnesium	5140	4980	29.6	ug/L	3		
SW	SW006	SW006005D	SW006005	SMETCLP	Manganese	108	76.3	15	ug/L	34		
SW	SW006	SW006006D	SW006006	SMETCLP	Manganese	28.8	29.4	15	ug/L	2		
SW	SW006	SW006007D	SW006007	SMETCLP	Manganese	30.2	32.4	10	ug/L	7		
SW	SW006	SW006008D	SW006008	SMETCLP	Manganese	25.8	32.7	10	ug/L	24		
SW	SW006	SW00690001D	SW00690001D	SMETCLP	Manganese	111	116		ug/L	4		
SW	SW006	SW00690003D	SW00690003D	SMETCLP	Manganese	159	174		ug/L	9		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Manganese	63.4	83.7	1	ug/L	28		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Manganese	35.2	38.3	2.1	ug/L	8		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Potassium	2200	2300	94.8	ug/L	4		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Potassium	3100	3270	10	ug/L	5		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Potassium	3660	3560	77.9	ug/L	3		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Silicon	4010	3820	10	ug/L	5		
SW	SW006	SW006006D	SW006006	SMETCLP	Sodium	25700	23000	5	ug/L	11		
SW	SW006	SW006007D	SW006007	SMETCLP	Sodium	14500	15300	5	ug/L	5		
SW	SW006	SW006008D	SW006008	SMETCLP	Sodium	16500	16100	5	ug/L	2		
SW	SW006	SW00690001D	SW00690001D	SMETCLP	Sodium	17400	16200		ug/L	7		
SW	SW006	SW00690003D	SW00690003D	SMETCLP	Sodium	15900	21600		ug/L	30		
SW	SW006	SW00980WC	SW00980WC	SMETCLP	Sodium	31600	32100	21.4	ug/L	2		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Sodium	43900	45100	10	ug/L	3		
SW	SW006	SW02028WC	SW02028WC	SMETCLP	Sodium	24300	23000	28.3	ug/L	5		
SW	SW007	SW01081WC	SW01081WC	SMETCLP	Strontium	170	170	10	ug/L	0		
SW	SW006	SW006005D	SW006005	SMETCLP	Zinc	149	106	20	ug/L	34		
SW	SW006	SW006006D	SW006006	SMETCLP	Zinc	363	345	20	ug/L	5		
SW	SW006	SW006007D	SW006007	SMETCLP	Zinc	26.1	17.9	10	ug/L	37		
SW	SW006	SW00690001D	SW00690001D	SMETCLP	Zinc	129	134		ug/L	4		

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Surface Water Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Average RPD
;W	SW006	SW00690003D	SW00690003D	SMETCLP	Zinc	23.6	28.2		ug/L	18		
;W	SW006	SW02028WC	SW02028WC	SMETCLP	Zinc	4.7	7.6	2.1	ug/L	47		
;W	SW006	SW00690001	SW00690001	TRADS	Gross Alpha	1.2	3.3		pCi/L	-2	11	1
;W	SW006	SW00690003	SW00690003	TRADS	Gross Alpha	1.314	0.7254		pCi/L	0		
;W	SW006	SW00690001D	SW00690001D	TRADS	Gross Beta	3.9	5.3		pCi/L	-1		
;W	SW006	SW00690003D	SW00690003D	TRADS	Gross Beta	4.346	5.361		pCi/L	-1		
;W	SW006	SW00690001D	SW00690001D	TRADS	Plutonium-239/240	0.012	0.011		pCi/L	0		
;W	SW006	SW00690001D	SW00690001D	TRADS	Strontium-90	0.97	0.85		pCi/L	0		
;W	SW006	SW00690003D	SW00690003D	TRADS	Strontium-90	1.007	0.9143		pCi/L	0		
;W	SW006	SW00690001D	SW00690001D	TRADS	Uranium-234	0.51	0.47		pCi/L	0		
;W	SW006	SW00690003D	SW00690003D	TRADS	Uranium-234	0.3473	0.5062		pCi/L	0		
;W	SW006	SW00690003D	SW00690003D	TRADS	Uranium-235	0.06007	0.1167		pCi/L	0		
;W	SW006	SW00690003D	SW00690003D	TRADS	Uranium-238	0.397	0.3375		pCi/L	0		
;W	SW006	SW00980WC	SW00980WC	WQPL	Bicarbonate As CaCO3	102	114	10	mg/L	11	88	13
;W	SW007	SW01081WC	SW01081WC	WQPL	Bicarbonate As CaCO3	78.8	68.2	10	mg/L	14		
;W	SW006	SW01937WC	SW01937WC	WQPL	Bicarbonate As CaCO3	105	109	10	mg/L	4		
;W	SW006	SW02022WC	SW02022WC	WQPL	Bicarbonate As CaCO3	42.1	43.2	10	mg/L	3		
;W	SW006	SW02028WC	SW02028WC	WQPL	Bicarbonate As CaCO3	76	77.9	10	mg/L	2		
;W	SW006	SW00980WC	SW00980WC	WQPL	Chloride	11.8	14.4	5	mg/L	20		
;W	SW007	SW01081WC	SW01081WC	WQPL	Chloride	78.3	79.4	5	mg/L	1		
;W	SW006	SW01937WC	SW01937WC	WQPL	Chloride	12.1	12.7	5	mg/L	5		
;W	SW006	SW02028WC	SW02028WC	WQPL	Chloride	14.7	13.4	1.2	mg/L	9		
;W	SW006	SW00980WC	SW00980WC	WQPL	Dissolved Organic Carbon	10.8	12	1	mg/L	11		
;W	SW006	SW00980WC	SW00980WC	WQPL	Dissolved Organic Carbon	10.9	12	1	mg/L	10		
;W	SW006	SW00980WC	SW00980WC	WQPL	Dissolved Organic Carbon	10.8	12.1	1	mg/L	11		
;W	SW006	SW00980WC	SW00980WC	WQPL	Dissolved Organic Carbon	10.9	12.1	1	mg/L	10		
;W	SW006	SW01937WC	SW01937WC	WQPL	Dissolved Organic Carbon	10.9	10.7	1	mg/L	2		
;W	SW006	SW02022WC	SW02022WC	WQPL	Dissolved Organic Carbon	10	9	1	mg/L	11		
;W	SW006	SW02028WC	SW02028WC	WQPL	Dissolved Organic Carbon	12	12	1	mg/L	0		
;W	SW006	SW01937WC	SW01937WC	WQPL	Oil And Grease	18.2	17.8	5	mg/L	2		
;W	SW006	SW00980WC	SW00980WC	WQPL	Sulfate	21.2	20.5	5	mg/L	3		
;W	SW007	SW01081WC	SW01081WC	WQPL	Sulfate	10.1	13.6	5	mg/L	30		
;W	SW006	SW01937WC	SW01937WC	WQPL	Sulfate	18	18.3	5	mg/L	2		
;W	SW006	SW02022WC	SW02022WC	WQPL	Sulfate	13.8	17.3	5	mg/L	23		
;W	SW006	SW02028WC	SW02028WC	WQPL	Sulfate	23.4	21.1	2.5	mg/L	10		
;W	SW006	SW00980WC	SW00980WC	WQPL	Total Dissolved Solids	258	240	10	mg/L	7		
;W	SW007	SW01081WC	SW01081WC	WQPL	Total Dissolved Solids	234	256	10	mg/L	9		
;W	SW006	SW01937WC	SW01937WC	WQPL	Total Dissolved Solids	189	191	10	mg/L	1		

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Surface Water Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Precision (+/-)
SW	SW006	SW02022WC	SW02022WC	WQPL	Total Dissolved Solids	152	132	10	mg/L	14		
SW	SW006	SW02028WC	SW02028WC	WQPL	Total Dissolved Solids	382	242	10	mg/L	45		
SW	SW006	SW00980WC	SW00980WC	WQPL	Total Organic Carbon	11.5	11.8	1	mg/L	3		
SW	SW006	SW00980WC	SW00980WC	WQPL	Total Organic Carbon	11.9	11.8	1	mg/L	1		
SW	SW006	SW00980WC	SW00980WC	WQPL	Total Organic Carbon	11.5	12.2	1	mg/L	6		
SW	SW006	SW00980WC	SW00980WC	WQPL	Total Organic Carbon	11.9	12.2	1	mg/L	2		
SW	SW006	SW01937WC	SW01937WC	WQPL	Total Organic Carbon	11.3	12.4	1	mg/L	9		
SW	SW006	SW02022WC	SW02022WC	WQPL	Total Organic Carbon	11	10	1	mg/L	10		
SW	SW006	SW02028WC	SW02028WC	WQPL	Total Organic Carbon	15	16	1	mg/L	6		
SW	SW006	SW00980WC	SW00980WC	WQPL	Total Suspended Solids	13	16	5	mg/L	21		
SW	SW007	SW01081WC	SW01081WC	WQPL	Total Suspended Solids	10	15	5	mg/L	40		
SW	SW006	SW01937WC	SW01937WC	WQPL	Total Suspended Solids	8	6	5	mg/L	29		
SW	SW006	SW02022WC	SW02022WC	WQPL	Total Suspended Solids	7	18	5	mg/L	88		

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Table B3
Sediment Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Change RPD
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Aluminum	3100	4210	3	mg/kg	30	104	26
SED	SED004	SED04001D	SED04001	SMETCLP	Aluminum	3070	6850	3	mg/kg	76		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Aluminum	7290	6300	3	mg/kg	15		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Aluminum	7290	6300	3	mg/kg	15		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Barium	131	109	20	mg/kg	18		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Beryllium	0.52	0.44	0.2	mg/kg	17		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Calcium	2650	2310	100	mg/kg	14		
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Chromium	4.7	4.6	2	mg/kg	2		
SED	SED004	SED04001D	SED04001	SMETCLP	Chromium	11	30.4	2	mg/kg	94		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Chromium	15.1	12.7	2	mg/kg	17		
SED	SED004	SED04001D	SED04001	SMETCLP	Copper	7.7	22	1	mg/kg	96		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Copper	12.4	10.2	1	mg/kg	19		
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Iron	5950	4200	20	mg/kg	34		
SED	SED004	SED04001D	SED04001	SMETCLP	Iron	6900	15000	20	mg/kg	74		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Iron	11200	9210	5	mg/kg	20		
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Lead	6.2	4.4	1	mg/kg	34		
SED	SED004	SED04001D	SED04001	SMETCLP	Lead	14	5.9	1	mg/kg	81		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Lead	21.7	68.8	20	mg/kg	104		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Magnesium	1570	1340	0.1	mg/kg	16		
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Manganese	202	352	3	mg/kg	54		
SED	SED004	SED04001D	SED04001	SMETCLP	Manganese	139	303	3	mg/kg	74		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Manganese	76.2	60.1	3	mg/kg	24		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Manganese	76.2	60.1	3	mg/kg	24		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Nickel	9.2	8.4	5	mg/kg	9		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Nickel	9.2	8.4	5	mg/kg	9		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Potassium	1040	868	10	mg/kg	18		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Sodium	152	138	10	mg/kg	10		
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Vanadium	12.8	24.2	8	mg/kg	62		
SED	SED004	SED04001D	SED04001	SMETCLP	Vanadium	12.9	30.6	8	mg/kg	81		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Vanadium	21.3	17.5	8	mg/kg	20		
SED	SED004	SED004001BD	SED004001BD	SMETCLP	Zinc	76.4	49.9	4	mg/kg	42		
SED	SED004	SED04001D	SED04001	SMETCLP	Zinc	26	70.3	4	mg/kg	92		
SED	SED023	SS00147WC	SS00147WC	SMETCLP	Zinc	41.1	33.4	4	mg/kg	21		

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Table B3
Sediment Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Maximum RPD	Average RPD
SED	SED004	SED004001BD	SED004001BD	TRADS	Gross Alpha	8.9	12.3	4.8	pCi/g	0.600	3	1
SED	SED023	SS00147WC	SS00147WC	TRADS	Gross Alpha	13.39	12.41	4	pCi/g	0.165		
SED	SED004	SED004001BD	SED004001BD	TRADS	Gross Beta	35.7	43.4	4.8	pCi/g	0.144		
SED	SED023	SS00147WC	SS00147WC	TRADS	Gross Beta	30.85	30.38	10	pCi/g	0.077		
SED	SED004	SED004001BD	SED004001BD	TRADS	Plutonium-239/240	0.015	0.072	0	pCi/g	3.350		
SED	SED023	SS00147WC	SS00147WC	TRADS	Plutonium-239/240	0.01068	0.01526	0	pCi/g	0.327		
SED	SED023	SS00147WC	SS00147WC	TRADS	Strontium-90	2.019	0.3118	0.07	pCi/g	2.510		
SED	SED004	SED004001BD	SED004001BD	TRADS	Uranium-234	0.38	1.03	0.03	pCi/g	2.780		
SED	SED023	SS00147WC	SS00147WC	TRADS	Uranium-234	2.104	1.922	0	pCi/g	0.253		
SED	SED004	SED004001BD	SED004001BD	TRADS	Uranium-235	0.02	0.03	1	pCi/g	0.277		
SED	SED004	SED004001BD	SED004001BD	TRADS	Uranium-238	0.39	0.89	0.04	pCi/g	2.280		
SED	SED023	SS00147WC	SS00147WC	TRADS	Uranium-238	1.971	1.575	0.158	pCi/g	0.610		

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Table B4
Surface Soil Field Duplicate Results

Sample Type	Location	Duplicate Sample Number	Original Sample Number	Method	Analyte	Duplicate Result	Original Result	Detection Limit	Units	RPD	Max RPD	RPD
SS	AN50-000	04F0732-004	AN50-000A	ALPHA SPEC	Uranium-234	0.504	0.71	0.384	pCi/g	0.390	0.390	0.351
SS	AN50-000	04F0732-004	AN50-000A	ALPHA SPEC	Uranium-238	0.65	0.83	0.368	pCi/g	0.312		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Aluminum	13000	18000	5.3	mg/kg	32	42	29
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Iron	12000	15000	1.5	mg/kg	22		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Lead	30	44	0.29	mg/kg	38		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Lithium	8.3	11	0.53	mg/kg	28		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Magnesium	1600	2200	8.2	mg/kg	32		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Manganese	230	320	0.19	mg/kg	33		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Mercury	0.026	0.028	0.0075	mg/kg	7		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Molybdenum	0.65	0.82	0.32	mg/kg	23		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Nickel	7.8	11	0.21	mg/kg	34		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Potassium	1800	2500	39	mg/kg	33		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Strontium	17	23	0.064	mg/kg	30		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Titanium	230	290	0.095	mg/kg	23		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Arsenic	7.1	9.2	0.88	mg/kg	26		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Barium	91	130	0.4	mg/kg	35		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Boron	5	6.4	1.1	mg/kg	25		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Chromium	13	16	0.16	mg/kg	21		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Cobalt	4.1	6	0.2	mg/kg	38		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Copper	8.7	13	0.049	mg/kg	40		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Vanadium	26	34	0.51	mg/kg	27		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Zinc	33	47	0.49	mg/kg	35		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Calcium	1700	2600	7.7	mg/kg	42		
SS	AN50-000	04F0732-004	AN50-000A	SW-846 6010	Silica	640	790	4.7	mg/kg	21		

Table B5
Field Duplicate Frequency

Test Method	Number of Real Samples	Number of Duplicate Samples	Percent Duplicates Required	Percent of Duplicates
Groundwater Samples				
BNACLP	9	0	5%	0.00%
Dissolved Metals	176	14	5%	7.95%
DRADS	97	10	5%	10.31%
DWQPL	10	0	5%	0.00%
Total Metals	66	3	5%	4.55%
PESTCLP	8	0	5%	0.00%
TRADS	87	4	5%	4.60%
VOACLP	119	9	5%	7.56%
WQPL	112	10	5%	8.93%
Surface Water Samples				
BNACLP	4	1	5%	25.00%
Dissolved Metals	82	16	5%	19.51%
DRADS	18	3	5%	16.67%
Total Metals	108	17	5%	15.74%
PESTCLP	4	1	5%	25.00%
TRADS	55	13	5%	23.64%
VOACLP	31	5	5%	16.13%
WQPL	200	23	5%	11.50%
Sediment Samples				
BNACLP	20	1	5%	5.00%
DMETALS	4	0	5%	0.00%
TMETALS	33	4	5%	12.12%
PESTCLP	20	1	5%	5.00%
TRADS	22	3	5%	13.64%
VOACLP	20	1	5%	5.00%
WQPL	24	3	5%	12.50%
Surface Soil Samples				
Alpha Spec	10	1	5%	10.00%
Gamma Specroscopy	1	0	5%	0.00%
SW-846 6010	10	1	5%	10.00%

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Results Exceeding Field Duplicate Precision Goals

Impacts to Data Based on a Comparison of Highest Detected Values and Applicable PRGs

Sample Type	Analysis	Target Analyte or Compound	Highest RPD/DER	Highest Detect in Data Set	Units	Applicable PRG	Potential Impact to Data?
GW	Total Metals (METADD, SMETCLP)	Chromium	64%	0.25	mg/L	3,041.4	No
GW	Total Metals (METADD, SMETCLP)	Iron	38%	30.40	mg/L	608.3	No
GW	Total Metals (METADD, SMETCLP)	Manganese	47%	1.93	mg/L	283.9	No
GW	Water Quality Parameters (WQPL)	Carbonate as CaCO3	32%	230.00	mg/L	NA	No
GW	Water Quality Parameters (WQPL)	Total Suspended Solids	128%	5,300,000.00	µg/L	NA	No
GW	Water Quality Parameters (WQPL)	Total Suspended Solids	25%	5,300,000.00	µg/L	NA	No
SW	Dissolved Metals (DMETADD, DMETCLP, DSMETCLP)	Barium	27%	0.63	mg/L	141.9	No
SW	Dissolved Metals (DMETADD, DMETCLP, DSMETCLP)	Copper	80%	0.05	mg/L	81.1	No
SW	Dissolved Metals (DMETADD, DMETCLP, DSMETCLP)	Iron	24%	3.90	mg/L	608.3	No
SW	Dissolved Metals (DMETADD, DMETCLP, DSMETCLP)	Iron	34%	3.90	mg/L	608.3	No
SW	Dissolved Metals (DMETADD, DMETCLP, DSMETCLP)	Potassium	30%	15.40	mg/L	NA	No
SW	Dissolved Metals (DMETADD, DMETCLP, DSMETCLP)	Zinc	39%	0.35	mg/L	608.3	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Silicon	63%	177.00	mg/L	NA	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Silicon	142%	177.00	mg/L	NA	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Aluminum	109%	129.00	mg/L	2,027.8	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Aluminum	46%	129.00	mg/L	2,027.8	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Iron	71%	88.60	mg/L	608.3	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Iron	56%	88.60	mg/L	608.3	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Iron	21%	88.60	mg/L	608.3	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Lead	38%	0.05	mg/L	NA	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Manganese	34%	1.93	mg/L	283.9	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Manganese	24%	1.93	mg/L	283.9	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Manganese	28%	1.93	mg/L	283.9	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Sodium	30%	45.40	mg/L	NA	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Zinc	34%	0.35	mg/L	608.3	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Zinc	37%	0.35	mg/L	608.3	No
SW	Total Metals (METADD, METCLP, SMETCLP)	Zinc	47%	0.35	mg/L	608.3	No
SW	Total Rads (TRADS)	Gross Alpha	2.23	45.00	pCi/L	NA	No
SW	Water Quality Paramters (WQPL)	Sulfate	30%	66,000.00	µg/L	NA	No
SW	Water Quality Paramters (WQPL)	Sulfate	23%	66,000.00	µg/L	NA	No
SW	Water Quality Paramters (WQPL)	Total Dissolved Solids	45%	540,000.00	µg/L	NA	No
SW	Water Quality Paramters (WQPL)	Total Suspended Solids	21%	1,600,000.00	µg/L	NA	No
SW	Water Quality Paramters (WQPL)	Total Suspended Solids	40%	1,600,000.00	µg/L	NA	No
SW	Water Quality Paramters (WQPL)	Total Suspended Solids	29%	1,600,000.00	µg/L	NA	No
SW	Water Quality Paramters (WQPL)	Total Suspended Solids	88%	1,600,000.00	µg/L	NA	No

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Results Exceeding Field Duplicate Precision Goals

Impacts to Data Based on a Comparison of Highest Detected Values and Applicable PRGs

Sample Type	Analysis	Target Analyte or Compound	Highest RPD/DER	Highest Detect in Data Set	Units	Applicable PRG	Potential Impact
SED	Total Metals (SMETCLP)	Aluminum	76%	19,400.00	mg/kg	24,774.1	No
SED	Total Metals (SMETCLP)	Chromium	94%	30.40	mg/kg	166,630.4	No
SED	Total Metals (SMETCLP)	Copper	96%	25.90	mg/kg	4,443.5	No
SED	Total Metals (SMETCLP)	Iron	74%	23,400.00	mg/kg	33,326.1	No
SED	Total Metals (SMETCLP)	Lead	81%	68.80	mg/kg	1,000.0	No
SED	Total Metals (SMETCLP)	Lead	104%	68.80	mg/kg	1,000.0	No
SED	Total Metals (SMETCLP)	Manganese	54%	470.00	mg/kg	NA	No
SED	Total Metals (SMETCLP)	Manganese	74%	470.00	mg/kg	NA	No
SED	Total Metals (SMETCLP)	Vanadium	61.60%	51.90	mg/kg	111.1	No
SED	Total Metals (SMETCLP)	Vanadium	81%	51.90	mg/kg	111.1	No
SED	Total Metals (SMETCLP)	Zinc	42%	720.00	mg/kg	33,326.1	No
SED	Total Metals (SMETCLP)	Zinc	92%	720.00	mg/kg	33,326.1	No
SED	Total Rads (TRADS)	plutonium-239/240	3.35	0.072	pCi/g	9.8	No
SED	Total Rads (TRADS)	strontium-90	2.51	0.5284	pCi/g	13.2	No
SED	Total Rads (TRADS)	uranium-234	2.78	3.079	pCi/g	25.3	No
SED	Total Rads (TRADS)	uranium-238	2.28	2.81	pCi/g	29.3	No
SS	Total Metals (SW-846 6010)	Lead	38%	48	mg/kg	1,000.0	No
SS	Total Metals (SW-846 6010)	Cobalt	38%	6.4	mg/kg	4,443.5	No
SS	Total Metals (SW-846 6010)	Copper	40%	13	mg/kg	121.8	No
SS	Total Metals (SW-846 6010)	Calcium	42%	4600	mg/kg	NA	No

Notes:

NA - PRGs have not been developed for these analytes or compounds

Table B7
Matrix Spike Duplicate Frequency

Method	Sample Type	Number of MSD Samples	Total Number of Samples	Percent Required	Percent MSD Samples
BNACLP	BH	2	7	5%	28.57%
	GW	0	9	5%	0.00%
	SED	8	24	5%	33.33%
DWQPL	SW	0	10	5%	0.00%
E130.2 SM2340C	SW	0	7	5%	0.00%
E300.0	SW	0	10	5%	0.00%
E375.1	SW	0	25	5%	0.00%
E600	SW	0	8	5%	0.00%
IONS	SW	0	2	5%	0.00%
PESTCLP	GW	0	8	5%	0.00%
	SED	8	19	5%	42.11%
	SW	0	3	5%	0.00%
EPA 524.2	GW	0	28	5%	0.00%
VOACLP	BH	0	6	5%	0.00%
	GW	7	91	5%	7.69%
	SED	6	20	5%	30.00%
	SW	10	31	5%	32.26%
WQPL	BH	0	7	5%	0.00%
	GW	0	112	5%	0.00%
	SED	0	24	5%	0.00%
	SW	5	58	5%	8.62%

Table B8
Matrix Spike Duplicate
RPD Results

Method	Sample type	Analyte	Minimum RPD	Maximum RPD	Average RPD
BNACLP	SED	1,4-Dichlorobenzene	0.00	28.95	6.85
BNACLP	SED	2,4-Dinitrotoluene	1.09	7.27	3.89
BNACLP	SED	2-Chlorophenol	0.00	26.42	7.78
BNACLP	SED	4-Chloro-3-methylphenol	1.31	11.61	6.45
BNACLP	SED	4-Nitrophenol	0.00	32.97	13.67
BNACLP	SED	Acenaphthene	0.00	10.34	3.21
BNACLP	SED	n-Nitrosodipropylamine	1.77	21.28	8.96
BNACLP	SED	Pentachlorophenol	2.70	30.56	13.37
BNACLP	SED	Phenol	0.00	22.22	8.80
BNACLP	SED	Pyrene	0.00	8.70	3.93
PESTCLP	SED	4,4'-DDT	1.29	13.04	6.28
PESTCLP	SED	Aldrin	0.90	11.24	4.77
PESTCLP	SED	Dieldrin	0.00	11.49	4.96
PESTCLP	SED	Endrin	1.03	13.08	5.61
PESTCLP	SED	gamma-BHC	1.38	9.01	5.41
PESTCLP	SED	Heptachlor	1.31	6.19	4.10
VOACLP	GW	1,1-Dichloroethene	0.92	10.99	4.92
VOACLP	GW	Benzene	0.00	5.83	2.09
VOACLP	GW	Chlorobenzene	0.97	8.00	2.49
VOACLP	GW	Toluene	0.95	6.76	3.08
VOACLP	GW	Trichloroethene	1.08	6.32	3.27
VOACLP	SED	1,1-Dichloroethene	0.00	7.35	3.20
VOACLP	SED	Benzene	0.00	10.84	4.00
VOACLP	SED	Chlorobenzene	0.90	12.24	7.33
VOACLP	SED	Toluene	0.92	11.21	5.89
VOACLP	SED	Trichloroethene	0.84	6.52	2.63
VOACLP	SW	1,1-Dichloroethene	0.94	13.95	4.04
VOACLP	SW	Benzene	1.09	6.32	3.70
VOACLP	SW	Chlorobenzene	1.00	6.00	3.20
VOACLP	SW	Toluene	0.00	10.73	5.06
VOACLP	SW	Trichloroethene	0.00	4.93	2.50
WQPL	SW	CHLORIDE	0.00	0.00	0.00
WQPL	SW	FLUORIDE	3.92	3.92	3.92
WQPL	SW	NITRATE/NITRITE	8.62	8.62	8.62
WQPL	SW	Nitrite	0.00	0.00	0.00
WQPL	SW	PHOSPHORUS	0.00	9.52	4.76
WQPL	SW	Sulfate	0.00	0.00	0.00

Table B9
Laboratory Duplicate Results

Sample Type	Laboratory Duplicate Sample Number	Lab Sample Number	Method	Analyte	Original Result	Sigma Error	Duplicate Result	Sigma Error	Units	RPD	Average RPD	Maximum RPD	DER
SS	D4C050365-001X	D4C050365-001	ALPHA SPEC	Uranium-238	0.922	0.484	0.756	0.396	pCi/g	20	20	29	0.27
SS	D4C150205-001X	D4C150205-001	ALPHA SPEC	Uranium-234	1.27	0.712	0.945	0.474	pCi/g	29			0.38
SS	D4C150205-001X	D4C150205-001	ALPHA SPEC	Uranium-238	0.678	0.518	0.616	0.376	pCi/g	10			0.10
SW	9802G408-003	9802G408-003	CLP-SOW-TOTAL	Chromium	0.84		0.68		mg/L	21	15	21	
SW	9802G408-003	9802G408-003	CLP-SOW-TOTAL	Lead	0.66		0.6		mg/L	10			
SW	SW02028WC	SW02028WCLR	TRADS	Americium-241	0	0.00594	0	0.00385	pCi/L	0	69	154	0
SW	SW02028WC	SW02028WCLR	TRADS	Cesium-137	0.2324	0.614	0.119	0.68	pCi/L	65			0.124
SW	SW02028WC	SW02028WCLR	TRADS	GROSS ALPHA	0.7477	0.702	1.559	0.964	pCi/L	70			-0.68
SW	SW02028WC	SW02028WCLR	TRADS	GROSS ALPHA	0.7477	0.702	0.2054	0.316	pCi/L	114			0.704
SW	SW02028WC	SW02028WCLR	TRADS	Plutonium-239/240	0.001034	0.00407	0.004773	0.00543	pCi/L	129			-0.55
SW	SW02028WC	SW02028WCLR	TRADS	Tritium	162.3	241	88.09	237	pCi/L	59			0.22
SW	SW02028WC	SW02028WCLR	TRADS	Uranium-234	0.08654	0.172	0.02206	0.103	pCi/L	119			0.322
SW	SW01937WC	SW01937WCLR	TRADS	Uranium-234	0.29	0.18	0.37	0.21	pCi/L	24			-0.29
SW	SW02028WC	SW02028WCLR	TRADS	Uranium-235	-0.00962	0.0137	-0.00802	0.0114	pCi/L	18			-0.09
SW	SW02028WC	SW02028WCLR	TRADS	Uranium-238	0.1707	0.21	0.02206	0.103	pCi/L	154			0.635
SW	SW01937WC	SW01937WCLR	TRADS	Uranium-238	0.29	0.18	0.27	0.17	pCi/L	7			0.081

Table B10
Laboratory Duplicate Frequency

Method	Sample Type	Number of Duplicate Samples	Total Number of Samples	Percent Required	Percent Duplicate Samples
ALPHA SPEC	SS	3	10	5%	30.00%
CLP-SOW	SW	0	2	5%	0.00%
CLP-SOW-TOTAL	SW	1	18	5%	5.56%
DMETADD	GW	0	70	5%	0.00%
	SED	0	2	5%	0.00%
	SW	0	26	5%	0.00%
DMETCLP	SW	0	8	5%	0.00%
DSMETCLP	GW	0	104	5%	0.00%
	SW	0	8	5%	0.00%
DRADS	GW	0	97	5%	0.00%
	SED	0	2	5%	0.00%
	SW	3	45	5%	6.67%
METADD	BH	0	7	5%	0.00%
	GW	0	33	5%	0.00%
	SED	0	11	5%	0.00%
	SW	0	26	5%	0.00%
METCLP	BH	0	16	5%	0.00%
	GW	0	1	5%	0.00%
	SED	0	4	5%	0.00%
	SW	0	10	5%	0.00%
SMETCLP	BH	0	7	5%	0.00%
	GW	0	31	5%	0.00%
	SED	0	18	5%	0.00%
	SW	0	46	5%	0.00%
SW-846 6010	SS	0	10	5%	0.00%
TRADS	BH	0	23	5%	0.00%
	GW	0	87	5%	0.00%
	SED	0	22	5%	0.00%
	SW	4	55	5%	7.27%

Table B11
Groundwater Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery %	Maximum Recovery %	Average Recovery %
GW	BNACLP	1,2,4-Trichlorobenzene	77	77	77.00
GW	BNACLP	1,4-Dichlorobenzene	81	81	81.00
GW	BNACLP	2,4-Dinitrotoluene	86	86	86.00
GW	BNACLP	2-Chlorophenol	61	61	61.00
GW	BNACLP	4-Chloro-3-Methylphenol	58	58	58.00
GW	BNACLP	4-Nitrophenol	29	29	29.00
GW	BNACLP	Acenaphthene	85	85	85.00
GW	BNACLP	N-Nitrosodipropylamine	40	40	40.00
GW	BNACLP	Pentachlorophenol	70	70	70.00
GW	BNACLP	Phenol	33	33	33.00
GW	BNACLP	Pyrene	86	86	86.00
GW	DMETADD	Cesium	85.5	118	102.60
GW	DMETADD	Lithium	84.9	104.6	98.26
GW	DMETADD	Molybdenum	92.8	102.6	99.34
GW	DMETADD	Silicon	102	116	107.18
GW	DMETADD	Strontium	91.7	103	98.90
GW	DMETADD	Tin	91.4	110	99.58
GW	DSMETCLP	Aluminum	94.3	104	98.50
GW	DSMETCLP	Antimony	93.1	113	101.62
GW	DSMETCLP	Arsenic	97.5	111	103.84
GW	DSMETCLP	Barium	95.7	99	97.44
GW	DSMETCLP	Beryllium	97.4	110	100.82
GW	DSMETCLP	Cadmium	100.8	103	102.00
GW	DSMETCLP	Calcium	101.8	101.8	101.80
GW	DSMETCLP	Chromium	95.4	103	99.00
GW	DSMETCLP	Cobalt	97.9	102.1	100.30
GW	DSMETCLP	Copper	98	103.2	100.76
GW	DSMETCLP	Iron	92.1	106	98.56
GW	DSMETCLP	Lead	100.5	113.5	105.30
GW	DSMETCLP	Magnesium	100.2	100.2	100.20
GW	DSMETCLP	Manganese	75	101.3	94.72
GW	DSMETCLP	Mercury	91.2	104.1	100.64
GW	DSMETCLP	Nickel	97.2	106	100.46
GW	DSMETCLP	Potassium	99.1	99.1	99.10
GW	DSMETCLP	Selenium	90	114	103.32
GW	DSMETCLP	Silver	88	112	96.86
GW	DSMETCLP	Sodium	101.7	101.7	101.70
GW	DSMETCLP	Thallium	80	101	93.26
GW	DSMETCLP	Vanadium	85.2	102	94.94
GW	DSMETCLP	Zinc	96.5	106	100.08
GW	DWQPL	Orthophosphate	98.3	104.7	101.50
GW	METADD	Cesium	82	96.9	90.85
GW	METADD	Lithium	83	101.6	95.48
GW	METADD	Molybdenum	92	100.2	96.10
GW	METADD	Silicon	308.6	483.9	383.87
GW	METADD	Strontium	91.6	99.2	95.23
GW	METADD	Tin	91	99	93.90
GW	PESTCLP	4,4'-DDT	58	58	58.00
GW	PESTCLP	Aldrin	68	68	68.00

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Table B11
Groundwater Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
GW	PESTCLP	Di-Butylchlorendate	69	69	69.00
GW	PESTCLP	Dieldrin	83	83	83.00
GW	PESTCLP	Endrin	85	85	85.00
GW	PESTCLP	Gamma-BHC	62	62	62.00
GW	PESTCLP	Heptachlor	74	74	74.00
GW	SMETCLP	Aluminum	97.5	341	192.92
GW	SMETCLP	Antimony	85.5	96.1	90.73
GW	SMETCLP	Arsenic	73	92.8	85.70
GW	SMETCLP	Barium	94.3	100.4	96.78
GW	SMETCLP	Beryllium	94.5	98.4	96.50
GW	SMETCLP	Cadmium	95.1	104.8	99.78
GW	SMETCLP	Calcium	100.8	100.8	100.80
GW	SMETCLP	Chromium	92.4	101.4	98.25
GW	SMETCLP	Cobalt	95.9	102.4	99.33
GW	SMETCLP	Copper	96.2	99.3	98.28
GW	SMETCLP	Iron	-33.1	166.3	95.00
GW	SMETCLP	Lead	93	104	98.50
GW	SMETCLP	Magnesium	102.1	102.1	102.10
GW	SMETCLP	Manganese	61.6	99.8	88.53
GW	SMETCLP	Mercury	100.9	131	112.78
GW	SMETCLP	Nickel	94.4	102.3	98.28
GW	SMETCLP	Potassium	100.4	100.4	100.40
GW	SMETCLP	Selenium	87.3	98	90.83
GW	SMETCLP	Silver	88.2	107.2	94.20
GW	SMETCLP	Sodium	101.5	101.5	101.50
GW	SMETCLP	Thallium	82	95	87.05
GW	SMETCLP	Vanadium	88.2	100.1	92.30
GW	SMETCLP	Zinc	95	104	100.08
GW	VOA524.2	1,1,1,2-Tetrachloroethane	92	116	103.75
GW	VOA524.2	1,1,1-Trichloroethane	95	117	103.50
GW	VOA524.2	1,1,2,2-Tetrachloroethane	85	115	104.25
GW	VOA524.2	1,1,2-Trichloroethane	95	114	103.50
GW	VOA524.2	1,1-Dichloroethane	99	124	109.75
GW	VOA524.2	1,1-Dichloroethene	97	147	112.50
GW	VOA524.2	1,1-Dichloropropene	99	124	110.00
GW	VOA524.2	1,2,3-Trichlorobenzene	104	114	108.50
GW	VOA524.2	1,2,3-Trichloropropane	86	116	104.00
GW	VOA524.2	1,2,4-Trichlorobenzene	101	116	108.50
GW	VOA524.2	Chloropropane	95	113	105.25
GW	VOA524.2	1,2-Dibromoethane	85	118	100.25
GW	VOA524.2	1,2-Dichlorobenzene	91	115	106.25
GW	VOA524.2	1,2-Dichloroethane	98	119	108.50
GW	VOA524.2	1,2-Dichloropropane	95	118	106.00
GW	VOA524.2	1,3-Dichloropropane	96	113	105.25
GW	VOA524.2	1,4-Dichlorobenzene	107	114	111.33
GW	VOA524.2	2,2-Dichloropropane	89	115	101.75
GW	VOA524.2	2-Chlorotoluene	95	111	102.25
GW	VOA524.2	4-Isopropyltoluene	97	111	106.25
GW	VOA524.2	Benzene	102	120	110.50

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Table B11
Groundwater Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum % Recovery	Maximum % Recovery	Average % Recovery
GW	VOA524.2	Benzene, 1,2,4-Trimethyl	97	110	103.75
GW	VOA524.2	Benzene, 1,3,5-Trimethyl-	99	111	106.50
GW	VOA524.2	Bromobenzene	99	114	107.25
GW	VOA524.2	Bromochloromethane	93	119	105.00
GW	VOA524.2	Bromodichloromethane	101	111	105.25
GW	VOA524.2	Bromoform	98	123	112.25
GW	VOA524.2	Bromomethane	94	111	104.00
GW	VOA524.2	Carbon Tetrachloride	101	126	109.25
GW	VOA524.2	Chlorobenzene	95	117	103.50
GW	VOA524.2	Chloroethane	86	135	109.50
GW	VOA524.2	Chloroform	100	121	107.50
GW	VOA524.2	Chloromethane	97.7	127	112.93
GW	VOA524.2	cis-1,2-Dichloroethene	105	121	109.75
GW	VOA524.2	cis-1,3-Dichloropropene	105	119	112.00
GW	VOA524.2	Dibromochloromethane	97	111	105.00
GW	VOA524.2	Dibromomethane	98	118	104.75
GW	VOA524.2	Dichlorodifluoromethane	111	166	137.00
GW	VOA524.2	Ethylbenzene	97	114	105.25
GW	VOA524.2	Hexachlorobutadiene	100	113	106.75
GW	VOA524.2	Isopropylbenzene	96	110	104.75
GW	VOA524.2	M+P Xylene	99	111	103.33
GW	VOA524.2	M-Dichlorobenzene	97	111	105.75
GW	VOA524.2	Methylene Chloride	100	126	108.50
GW	VOA524.2	Naphthalene	95	110	103.50
GW	VOA524.2	N-Butylbenzene	93	111	105.00
GW	VOA524.2	N-Propylbenzene	95	113	104.50
GW	VOA524.2	O-Xylene	98	107	103.00
GW	VOA524.2	P-Chlorotoluene	100	114	108.25
GW	VOA524.2	Sec-Butylbenzene	96	108	103.75
GW	VOA524.2	Styrene	98	115	107.50
GW	VOA524.2	Tert-Butylbenzene	98	110	105.75
GW	VOA524.2	Tetrachloroethene	97	112	105.25
GW	VOA524.2	Toluene	102	115	109.00
GW	VOA524.2	Trans-1,2-Dichloroethene	100	122	107.25
GW	VOA524.2	Trans-1,3-Dichloropropene	99	118	108.50
GW	VOA524.2	Trichloroethene	101	117	107.75
GW	VOA524.2	Trichlorofluoromethane	86.3	111	96.33
GW	VOA524.2	Vinyl Chloride	94	124	109.00
GW	VOA524.2	Xylene	119	119	119.00
GW	VOACLP	1,1-Dichloroethene	73	144	102.43
GW	VOACLP	Benzene	84	122	99.86
GW	VOACLP	Chlorobenzene	86	116	98.86
GW	VOACLP	Toluene	84	117	101.57
GW	VOACLP	Trichloroethene	79	115	94.57
GW	WQPL	Ammonia	17	90	56.68
GW	WQPL	Bicarbonate As CaCO3	92	98	95.00
GW	WQPL	Carbonate As CaCO3	92	98	95.00
GW	WQPL	Chloride	90	105.3	98.33
GW	WQPL	Cyanide	28	123	84.75

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Table B11
Groundwater Matrix Spike Results

Sample Type	Lab Test Method	Analyte	Minimum Recovery %	Maximum Recovery %	Average Recovery %
GW	WQPL	Fluoride	101	112	106.25
GW	WQPL	Nitrate/Nitrite	92	167	110.74
GW	WQPL	Orthophosphate	96	103	99.50
GW	WQPL	Sulfate	92	115	103.43

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Table B12
Surface Water Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum % Recovery	Maximum % Recovery	Average % Recovery
SW	CLP-SOW	Mercury	95	95	95.00
SW	CLP-SOW-TOTAL	Aluminum	58.1	458.7	258.40
SW	CLP-SOW-TOTAL	Antimony	68.4	93.2	84.00
SW	CLP-SOW-TOTAL	Arsenic	70.4	94	85.60
SW	CLP-SOW-TOTAL	Barium	90.5	91.6	91.05
SW	CLP-SOW-TOTAL	Beryllium	94.4	96	95.20
SW	CLP-SOW-TOTAL	Cadmium	90.2	116	98.87
SW	CLP-SOW-TOTAL	Chromium	92.2	129	106.57
SW	CLP-SOW-TOTAL	Cobalt	90.3	92.6	91.45
SW	CLP-SOW-TOTAL	Copper	89.8	92.7	91.25
SW	CLP-SOW-TOTAL	Iron	18.9	262.7	140.80
SW	CLP-SOW-TOTAL	Lead	88.8	105	94.73
SW	CLP-SOW-TOTAL	Lithium	98.8	109.2	104.00
SW	CLP-SOW-TOTAL	Manganese	92.7	96.7	94.70
SW	CLP-SOW-TOTAL	Mercury	94.1	94.1	94.10
SW	CLP-SOW-TOTAL	Molybdenum	88.6	88.8	88.70
SW	CLP-SOW-TOTAL	Nickel	89.1	90.4	89.75
SW	CLP-SOW-TOTAL	Selenium	59.6	93.1	81.93
SW	CLP-SOW-TOTAL	Silver	89.9	95.6	93.30
SW	CLP-SOW-TOTAL	Strontium	88.2	91.5	89.85
SW	CLP-SOW-TOTAL	Thallium	88.2	103	94.27
SW	CLP-SOW-TOTAL	Tin	91.3	91.7	91.50
SW	CLP-SOW-TOTAL	Vanadium	93.3	94.7	94.00
SW	CLP-SOW-TOTAL	Zinc	90.9	94.1	92.50
SW	DMETADD	Cesium	101.5	101.5	101.50
SW	DMETADD	Lithium	97.2	97.2	97.20
SW	DMETADD	Molybdenum	96.7	96.7	96.70
SW	DMETADD	Silicon	108.9	108.9	108.90
SW	DMETADD	Strontium	96.5	96.5	96.50
SW	DMETADD	Tin	98.8	98.8	98.80
SW	DMETCLP	Aluminum	114	114	114.00
SW	DMETCLP	Antimony	114	114	114.00
SW	DMETCLP	Arsenic	134	134	134.00
SW	DMETCLP	Barium	101	101	101.00
SW	DMETCLP	Beryllium	103	103	103.00
SW	DMETCLP	Cadmium	105	105	105.00
SW	DMETCLP	Cesium	117	117	117.00
SW	DMETCLP	Chromium	105	105	105.00
SW	DMETCLP	Cobalt	102	102	102.00
SW	DMETCLP	Copper	103	103	103.00
SW	DMETCLP	Iron	119	119	119.00
SW	DMETCLP	Lead	105	105	105.00
SW	DMETCLP	Lithium	109	109	109.00
SW	DMETCLP	Manganese	105	105	105.00
SW	DMETCLP	Mercury	98	98	98.00
SW	DMETCLP	Molybdenum	101	101	101.00
SW	DMETCLP	Nickel	102	102	102.00
SW	DMETCLP	Selenium	96	96	96.00
SW	DMETCLP	Silicon	115	115	115.00
SW	DMETCLP	Silver	102	102	102.00

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Table B12
Surface Water Matrix Spike Results

Sample Type	Prep Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
SW	DMETCLP	Strontium	107	107	107.00
SW	DMETCLP	Thallium	123	123	123.00
SW	DMETCLP	Tin	108	108	108.00
SW	DMETCLP	Vanadium	101	101	101.00
SW	DMETCLP	Zinc	99	99	99.00
SW	DSMETCLP	Aluminum	100.7	100.7	100.70
SW	DSMETCLP	Antimony	97.8	97.8	97.80
SW	DSMETCLP	Arsenic	104	104	104.00
SW	DSMETCLP	Barium	95.9	95.9	95.90
SW	DSMETCLP	Beryllium	93.3	93.3	93.30
SW	DSMETCLP	Cadmium	96.3	96.3	96.30
SW	DSMETCLP	Chromium	98.7	98.7	98.70
SW	DSMETCLP	Cobalt	103.3	103.3	103.30
SW	DSMETCLP	Copper	97.9	97.9	97.90
SW	DSMETCLP	Iron	100.6	100.6	100.60
SW	DSMETCLP	Lead	104.5	104.5	104.50
SW	DSMETCLP	Manganese	100.2	100.2	100.20
SW	DSMETCLP	Mercury	97.5	97.5	97.50
SW	DSMETCLP	Nickel	101.2	101.2	101.20
SW	DSMETCLP	Selenium	90	90	90.00
SW	DSMETCLP	Silver	91.9	91.9	91.90
SW	DSMETCLP	Thallium	90.4	90.4	90.40
SW	DSMETCLP	Vanadium	101.4	101.4	101.40
SW	DSMETCLP	Zinc	101.5	101.5	101.50
SW	E130.2, SM 2340C	Hardness	98	102	99.75
SW	F-B,C	Fluoride	79	126	99.33
SW	E300.0,SW9035/9036	Sulfate	78	121	98.22
SW	EPA 300.0	Chloride	95	126	106.86
SW	EPA 600	Calcium	95	95	95.00
SW	EPA 600	Iron	120	120	120.00
SW	EPA 600	Lithium	100	100	100.00
SW	EPA 600	Magnesium	99	99	99.00
SW	EPA 600	Mercury	92	99	95.50
SW	EPA 600	Potassium	98	98	98.00
SW	EPA 600	Sodium	100	100	100.00
SW	IONS	Chloride	100	107	103.50
SW	IONS	Fluoride	100	113	106.50
SW	IONS	Sulfate	101	110	105.50
SW	METADD	Cesium	98.5	98.5	98.50
SW	METADD	Lithium	97.8	97.8	97.80
SW	METADD	Molybdenum	95.2	95.2	95.20
SW	METADD	Silicon	342.2	342.2	342.20
SW	METADD	Strontium	96.9	96.9	96.90
SW	METADD	Tin	98.1	98.1	98.10
SW	METCLP	Aluminum	97.7	118	107.85
SW	METCLP	Antimony	94.9	101	97.95
SW	METCLP	Arsenic	87.6	117	102.30
SW	METCLP	Barium	95.5	102	98.75
SW	METCLP	Beryllium	100	106	103.00
SW	METCLP	Cadmium	93.2	105	99.10

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Table B12
Surface Water Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
SW	METCLP	Cesium	92	118	105.00
SW	METCLP	Chromium	96	107	101.50
SW	METCLP	Cobalt	95.4	102	98.70
SW	METCLP	Copper	96.3	103	99.65
SW	METCLP	Iron	99.3	116	107.65
SW	METCLP	Lead	101	112	106.50
SW	METCLP	Lithium	92	111	101.50
SW	METCLP	Manganese	95	105	100.00
SW	METCLP	Mercury	98	126	112.00
SW	METCLP	Molybdenum	93.1	101	97.05
SW	METCLP	Nickel	93.8	103	98.40
SW	METCLP	Selenium	71.2	83	77.10
SW	METCLP	Silicon	102	124	113.00
SW	METCLP	Silver	89.3	98	93.65
SW	METCLP	Strontium	95	108	101.50
SW	METCLP	Thallium	78.6	119	98.80
SW	METCLP	Tin	88.8	103	95.90
SW	METCLP	Vanadium	96.7	102	99.35
SW	METCLP	Zinc	95.4	98	96.70
SW	SMETCLP	Aluminum	134	244.7	189.35
SW	SMETCLP	Antimony	94.8	101	97.90
SW	SMETCLP	Arsenic	89.5	185	137.25
SW	SMETCLP	Barium	96.3	104	100.15
SW	SMETCLP	Beryllium	96	103	99.50
SW	SMETCLP	Cadmium	94	96.8	95.40
SW	SMETCLP	Chromium	99.3	105	102.15
SW	SMETCLP	Cobalt	102.2	104	103.10
SW	SMETCLP	Copper	98.8	101	99.90
SW	SMETCLP	Iron	113	192	152.50
SW	SMETCLP	Lead	98	206	152.00
SW	SMETCLP	Manganese	99.3	102	100.65
SW	SMETCLP	Mercury	101.6	103	102.30
SW	SMETCLP	Nickel	99.7	108	103.85
SW	SMETCLP	Selenium	81	190	135.50
SW	SMETCLP	Silver	89.1	103	96.05
SW	SMETCLP	Thallium	84.8	207	145.90
SW	SMETCLP	Vanadium	101.2	102	101.60
SW	SMETCLP	Zinc	101.1	102	101.55
SW	VOACLP	1,1-Dichloroethene	48	115	95.13
SW	VOACLP	Benzene	86	103	94.63
SW	VOACLP	Chlorobenzene	90	101	97.25
SW	VOACLP	Toluene	87	104	94.38
SW	VOACLP	Trichloroethene	84	100	94.50
SW	WQPL	Bicarbonate	94	94	94.00
SW	WQPL	Carbonate	94	94	94.00
SW	WQPL	Chloride	69	118	93.00
SW	WQPL	Cyanide	97	98.4	97.70
SW	WQPL	Dissolved Organic Carbon	80	100	96.00
SW	WQPL	Fluoride	88	109	97.80
SW	WQPL	Hydrogen Sulfide	85	105	95.00

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Table B12
Surface Water Matrix Spike Results

Sample Type	Laboratory	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
SW	WQPL	Nitrate	107	107	107.00
SW	WQPL	Nitrate/Nitrite	94	111	98.50
SW	WQPL	Nitrite	100	103	101.50
SW	WQPL	Oil and Grease	89	89	89.00
SW	WQPL	Orthophosphate	89	118	100.25
SW	WQPL	Phosphorus	91	108	99.67
SW	WQPL	Sulfate	0	101	77.00
SW	WQPL	Total Organic Carbon	87	110	95.78

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Table B13
Sediment Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
SED	BNACLP	1,2,4-Trichlorobenzene	47	85	65.00
SED	BNACLP	1,4-Dichlorobenzene	45	85	65.20
SED	BNACLP	2,4-Dinitrotoluene	46	95	71.00
SED	BNACLP	2-Chlorophenol	52	82	67.60
SED	BNACLP	4-Chloro-3-methylphenol	52	76	64.40
SED	BNACLP	4-Nitrophenol	38	90	63.40
SED	BNACLP	Acenaphthene	49	83	68.60
SED	BNACLP	n-Nitrosodipropylamine	52	86	62.60
SED	BNACLP	Pentachlorophenol	50	75	66.60
SED	BNACLP	Phenol	48	80	58.20
SED	BNACLP	Pyrene	60	85	73.00
SED	METADD	Cesium	92	92	92.00
SED	METADD	Lithium	91.5	91.5	91.50
SED	METADD	Molybdenum	89.2	89.2	89.20
SED	METADD	Strontium	87.7	87.7	87.70
SED	METADD	Tin	79.8	79.8	79.80
SED	METCLP	Antimony	90	90	90.00
SED	METCLP	Arsenic	107	107	107.00
SED	METCLP	Barium	103	103	103.00
SED	METCLP	Beryllium	97	97	97.00
SED	METCLP	Cadmium	93	93	93.00
SED	METCLP	Cesium	132	132	132.00
SED	METCLP	Chromium	98	98	98.00
SED	METCLP	Cobalt	97	97	97.00
SED	METCLP	Copper	98	98	98.00
SED	METCLP	Lead	85	85	85.00
SED	METCLP	Lithium	103	103	103.00
SED	METCLP	Manganese	100	100	100.00
SED	METCLP	Mercury	104	104	104.00
SED	METCLP	Molybdenum	103	103	103.00
SED	METCLP	Nickel	97	97	97.00
SED	METCLP	Selenium	69	69	69.00
SED	METCLP	Silver	92	92	92.00
SED	METCLP	Strontium	109	109	109.00
SED	METCLP	Thallium	115	115	115.00
SED	METCLP	Tin	111	111	111.00
SED	METCLP	Vanadium	100	100	100.00
SED	METCLP	Zinc	98	98	98.00
SED	PESTCLP	4,4'-DDT	49	124	89.67
SED	PESTCLP	Aldrin	47	111	81.83
SED	PESTCLP	Dieldrin	46	97	81.00
SED	PESTCLP	Endrin	57	101	87.83
SED	PESTCLP	gamma-BHC	58	88	78.00
SED	PESTCLP	Heptachlor	48	94	79.17
SED	SMETCLP	Antimony	57.6	111.8	84.70
SED	SMETCLP	Arsenic	92	92	92.00
SED	SMETCLP	Barium	98.7	98.7	98.70
SED	SMETCLP	Beryllium	95.5	95.5	95.50
SED	SMETCLP	Cadmium	94.5	94.5	94.50
SED	SMETCLP	Chromium	96.5	96.5	96.50

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Table B13
Sediment Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
SED	SMETCLP	Cobalt	96.6	96.6	96.60
SED	SMETCLP	Copper	99.3	99.3	99.30
SED	SMETCLP	Lead	88.6	88.6	88.60
SED	SMETCLP	Manganese	86.4	127.6	107.00
SED	SMETCLP	Mercury	98.9	98.9	98.90
SED	SMETCLP	Nickel	98.6	98.6	98.60
SED	SMETCLP	Selenium	94	94	94.00
SED	SMETCLP	Silver	77.3	77.3	77.30
SED	SMETCLP	Thallium	108.8	108.8	108.80
SED	SMETCLP	Vanadium	100.1	100.1	100.10
SED	SMETCLP	Zinc	86.6	86.6	86.60
SED	VOACLP	1,1-Dichloroethene	93	161	119.80
SED	VOACLP	Benzene	91	111	103.20
SED	VOACLP	Chlorobenzene	92	123	105.80
SED	VOACLP	Toluene	101	109	105.80
SED	VOACLP	Trichloroethene	89	119	104.40
SED	WQPL	Alkalinity	101	102	101.50
SED	WQPL	Nitrate/Nitrite	72	105	87.75

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Table B14
Surface Soil Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
SS	SW-846 6010	Aluminum	2040	2250	2145.00
SS	SW-846 6010	Antimony	45	50	47.50
SS	SW-846 6010	Arsenic	90	93	91.50
SS	SW-846 6010	Barium	99	104	101.50
SS	SW-846 6010	Beryllium	86	86	86.00
SS	SW-846 6010	Boron	84	86	85.00
SS	SW-846 6010	Cadmium	92	93	92.50
SS	SW-846 6010	Calcium	88	98	93.00
SS	SW-846 6010	Chromium	107	109	108.00
SS	SW-846 6010	Cobalt	92	95	93.50
SS	SW-846 6010	Copper	92	96	94.00
SS	SW-846 6010	Iron	36	293	164.50
SS	SW-846 6010	Lead	95	95	95.00
SS	SW-846 6010	Lithium	85	96	90.50
SS	SW-846 6010	Magnesium	92	98	95.00
SS	SW-846 6010	Manganese	97	123	110.00
SS	SW-846 6010	Mercury	96	97	96.50
SS	SW-846 6010	Molybdenum	87	92	89.50
SS	SW-846 6010	Nickel	93	96	94.50
SS	SW-846 6010	Potassium	102	114	108.00
SS	SW-846 6010	Selenium	90	91	90.50
SS	SW-846 6010	Silica	14	17	15.50
SS	SW-846 6010	Silver	98	99	98.50
SS	SW-846 6010	Sodium	86	91	88.50
SS	SW-846 6010	Strontium	96	99	97.50
SS	SW-846 6010	Thallium	87	91	89.00
SS	SW-846 6010	Tin	82	86	84.00
SS	SW-846 6010	TITANIUM	170	182	176.00
SS	SW-846 6010	Uranium, Total	90	94	92.00
SS	SW-846 6010	Vanadium	102	104	103.00
SS	SW-846 6010	Zinc	85	98	91.50

Table B15
Borehole Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
BH	BNACLP	1,2,4-Trichlorobenzene	64	65	64.50
BH	BNACLP	1,4-Dichlorobenzene	61	61	61.00
BH	BNACLP	2,4-Dinitrotoluene	63	66	64.50
BH	BNACLP	2-Chlorophenol	51	55	53.00
BH	BNACLP	4-Chloro-3-methylphenol	53	63	58.00
BH	BNACLP	4-Nitrophenol	64	79	71.50
BH	BNACLP	Acenaphthene	55	56	55.50
BH	BNACLP	n-Nitrosodipropylamine	59	60	59.50
BH	BNACLP	Pentachlorophenol	65	72	68.50
BH	BNACLP	Phenol	43	52	47.50
BH	BNACLP	Pyrene	53	67	60.00
BH	METADD	CESIUM	97.5	97.5	97.50
BH	METADD	Lithium	101.3	101.3	101.30
BH	METADD	Molybdenum	95.6	95.6	95.60
BH	METADD	Strontium	101.1	101.1	101.10
BH	METADD	Tin	95.9	95.9	95.90
BH	METCLP	Antimony	98	98	98.00
BH	METCLP	Arsenic	123	123	123.00
BH	METCLP	Barium	100	100	100.00
BH	METCLP	Beryllium	96	96	96.00
BH	METCLP	Cadmium	101	101	101.00
BH	METCLP	CESIUM	133	133	133.00
BH	METCLP	Chromium	107	107	107.00
BH	METCLP	Cobalt	100	100	100.00
BH	METCLP	Copper	102	102	102.00
BH	METCLP	Lead	78	78	78.00
BH	METCLP	Lithium	110	110	110.00
BH	METCLP	Manganese	166	166	166.00
BH	METCLP	Mercury	89	89	89.00
BH	METCLP	Molybdenum	98	98	98.00
BH	METCLP	Nickel	97	97	97.00
BH	METCLP	Selenium	88	88	88.00
BH	METCLP	Silver	103	103	103.00
BH	METCLP	Strontium	113	113	113.00
BH	METCLP	Thallium	113	113	113.00
BH	METCLP	Tin	104	104	104.00
BH	METCLP	Vanadium	105	105	105.00
BH	METCLP	Zinc	98	98	98.00
BH	SMETCLP	Antimony	30.1	30.1	30.10
BH	SMETCLP	Arsenic	84	84	84.00
BH	SMETCLP	Barium	101	101	101.00
BH	SMETCLP	Beryllium	96.7	96.7	96.70
BH	SMETCLP	Cadmium	101.7	101.7	101.70
BH	SMETCLP	Chromium	108.4	108.4	108.40
BH	SMETCLP	Cobalt	98.6	98.6	98.60
BH	SMETCLP	Copper	103.9	103.9	103.90
BH	SMETCLP	Lead	153	153	153.00
BH	SMETCLP	Manganese	106.8	106.8	106.80
BH	SMETCLP	Mercury	134.1	134.1	134.10
BH	SMETCLP	Nickel	100.1	100.1	100.10

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Table B15
Borehole Matrix Spike Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
BH	SMETCLP	Selenium	89	89	89.00
BH	SMETCLP	Silver	84.2	84.2	84.20
BH	SMETCLP	Thallium	99.2	99.2	99.20
BH	SMETCLP	Vanadium	105.4	105.4	105.40
BH	SMETCLP	Zinc	104.1	104.1	104.10
BH	VOACLP	1,1-Dichloroethene	113	113	113.00
BH	VOACLP	Benzene	108	108	108.00
BH	VOACLP	Chlorobenzene	108	108	108.00
BH	VOACLP	Toluene	108	108	108.00
BH	VOACLP	Trichloroethene	106	106	106.00
BH	WQPL	Cyanide	75	75	75.00
BH	WQPL	NITRATE/NITRITE	98	98	98.00

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Table B16
Matrix Spike Frequency

Method	Sample Type	Number of MS Samples	Total Number of Samples	Percent Required	Percent MS Samples
BNACLP	BH	2	7	5%	28.57%
	GW	1	9	5%	11.11%
	SED	7	24	5%	29.17%
CLP-SOW	SW	1	2	5%	50.00%
CLP-SOW-TOTAL	SW	2	18	5%	11.11%
DMETADD	GW	5	70	5%	7.14%
	SED	0	2	5%	0.00%
	SW	1	26	5%	3.85%
DMETCLP	SW	1	8	5%	12.50%
DSMETCLP	GW	5	104	5%	4.81%
	SW	6	8	5%	75.00%
DRADS	GW	0	97	5%	0.00%
	SED	0	2	5%	0.00%
	SW	2	45	5%	4.44%
DWQPL	SW	4	10	5%	40.00%
E130.2 SM2340C	SW	4	7	5%	57.14%
E300.0	SW	7	10	5%	70.00%
E375.1	SW	9	25	5%	36.00%
E600	SW	2	8	5%	25.00%
IONS	SW	2	2	5%	100.00%
METADD	BH	1	7	5%	14.29%
	GW	4	33	5%	12.12%
	SED	1	11	5%	9.09%
	SW	1	26	5%	3.85%
METCLP	BH	2	16	5%	12.50%
	GW	0	1	5%	0.00%
	SED	1	4	5%	25.00%
	SW	2	10	5%	20.00%
PESTCLP	GW	1	8	5%	12.50%
	SED	13	19	5%	68.42%
	SW	0	3	5%	0.00%
SMETCLP	BH	1	7	5%	14.29%
	GW	4	31	5%	12.90%
	SED	1	18	5%	5.56%
	SW	2	46	5%	4.35%
SW-846 6010	SS	3	10	5%	30.00%
TRADS	BH	1	23	5%	4.35%
	GW	0	87	5%	0.00%
	SED	0	22	5%	0.00%
	SW	7	55	5%	12.73%
EPA 524.2	GW	4	28	5%	14.29%
VOACLP	BH	3	6	5%	50.00%
	GW	7	91	5%	7.69%
	SED	6	20	5%	30.00%
	SW	9	31	5%	29.03%
WQPL	BH	1	7	5%	14.29%
	GW	7	112	5%	6.25%
	SED	4	24	5%	16.67%
	SW	14	58	5%	24.14%

Table B17
Ground Water Matrix Spike Duplicate Results

Sample Type	Test Method	Analyte	Minimum Recovery%	Maximum Recovery%	Average Recovery%
VOACLP	GW	1,1-Dichloroethene	69	129	99.29
VOACLP	GW	Benzene	82	118	97.71
VOACLP	GW	Chlorobenzene	85	113	99.14
VOACLP	GW	Toluene	83	114	98.71
VOACLP	GW	Trichloroethene	77	111	93.43

Table B18
Surface Water Matrix Spike Duplicate Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
DMETADD	SW	CESIUM	99.7	99.7	99.70
DMETADD	SW	SILICON	95.7	95.7	95.70
DMETCLP	SW	CESIUM	99.4	104	101.70
DMETCLP	SW	SILICON	148	148	148.00
METADD	SW	CESIUM	121	121	121.00
METADD	SW	SILICON	101	101	101.00
METCLP	SW	CESIUM	105	105	105.00
VOACLP	SW	1,1-Dichloroethene	51	111	93.13
VOACLP	SW	Benzene	89	99	93.88
VOACLP	SW	Chlorobenzene	87	106	97.63
VOACLP	SW	Toluene	85	108	94.25
VOACLP	SW	Trichloroethene	87	104	95.13
WQPL	SW	CHLORIDE	103	118	110.50
WQPL	SW	Cyanide	83.7	83.7	83.70
WQPL	SW	FLUORIDE	104	104	104.00
WQPL	SW	NITRATE/NITRITE	103	121	110.67
WQPL	SW	Nitrite	100	101	100.50
WQPL	SW	PHOSPHORUS	88.6	110	99.53
WQPL	SW	Sulfate	100	100	100.00
WQPL	SW	TOTAL DISSOLVED SOLIDS	112	112	112.00

Table B19
Sediment Matrix Spike Duplicate Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
BNACLP	SED	1,2,4-Trichlorobenzene	46	86	69.40
BNACLP	SED	1,4-Dichlorobenzene	44	87	69.40
BNACLP	SED	2,4-Dinitrotoluene	49	92	69.80
BNACLP	SED	2-Chlorophenol	51	90	70.20
BNACLP	SED	4-Chloro-3-methylphenol	54	82	66.00
BNACLP	SED	4-Nitrophenol	53	87	65.60
BNACLP	SED	Acenaphthene	49	84	67.00
BNACLP	SED	n-Nitrosodipropylamine	42	88	63.00
BNACLP	SED	Pentachlorophenol	56	83	71.40
BNACLP	SED	Phenol	48	81	59.80
BNACLP	SED	Pyrene	55	86	71.20
PESTCLP	SED	4,4'-DDT	43	128	88.17
PESTCLP	SED	Aldrin	42	112	81.50
PESTCLP	SED	Dieldrin	41	102	81.67
PESTCLP	SED	Endrin	50	102	87.67
PESTCLP	SED	gamma-BHC	53	94	78.83
PESTCLP	SED	Heptachlor	46	100	80.50
VOACLP	SED	1,1-Dichloroethene	98	160	123.00
VOACLP	SED	Benzene	97	111	106.00
VOACLP	SED	Chlorobenzene	104	128	113.60
VOACLP	SED	Toluene	109	114	112.20
VOACLP	SED	Trichloroethene	95	118	105.80

Table B20
Borehole Matrix Spike Duplicate Results

Sample Type	Test Method	Analyte	Minimum Recovery	Maximum Recovery	Average Recovery
VOACLP	BP	1,1-Dichloroethene	109	109	109.00
VOACLP	BP	Benzene	104	104	104.00
VOACLP	BP	Chlorobenzene	103	103	103.00
VOACLP	BP	Toluene	102	102	102.00
VOACLP	BP	Trichloroethene	94	94	94.00

Table B21
Laboratory Control Sample Results

Analyte	Minimum % Recovery	Maximum % Recovery	Average Recovery
Alkalinity, Total As CaCO3	93	105	98.75
Aluminum	86.9	110.2	99.78
Antimony	81.8	104.3	98.52
Arsenic	82.5	105.9	97.69
Barium	85.1	103.2	98.50
Beryllium	84.8	108.5	99.68
Bicarbonate As CaCO3	93	105	98.73
Boron	92	96	93.14
Bromide	100	102	101.00
Cadmium	85.6	105.1	98.74
Calcium	87	117.7	99.72
Chloride	93	110	99.76
Chromium	85.8	104.2	98.90
Cobalt	84.9	104.8	99.08
Copper	85.4	116.9	98.71
Fluoride	89	110	100.44
Hardness, Total	99	100	99.60
Iron	85.5	115	99.90
Lead	85.1	103.7	98.23
Lithium	87.8	108.8	102.58
Magnesium	86.1	106.5	100.33
Manganese	87.9	107.6	101.18
Mercury	80	112.5	100.33
Molybdenum	90	101.9	96.53
Nickel	85.1	104.3	98.82
Nitrate	80	94	89.33
Potassium	80.7	108	97.75
Selenium	82	109	97.84
Silica	17	25	21.00
Silver	81	110	98.74
Sodium	81	106	97.93
Strontium	81.3	102.9	97.98
Sulfate	90	106	96.94
Thallium	83.6	116	100.25
Tin	82.4	103.2	97.78
Titanium	95	98	95.86
Total Dissolved Solids	95	116	103.45
Total Suspended Solids	84	108	94.91
Uranium, Total	94.9	102	97.97
Vanadium	86.6	106	99.91
Zinc	85	104.8	98.77

Table B22
Laboratory Control Sample Frequency by Method

Method	Batch-Specific LCS	Total Number of Lab Batches	Percent Required	Percent LCS Samples
ALPHA SPEC	9	9	100%	100.00%
CLP-SOW	5	5	100%	100.00%
CLP-SOW-TOTAL	36	37	100%	97.30%
DMETADD	0	18	100%	0.00%
DMETCLP	0	5	100%	0.00%
DSMETCLP	0	19	100%	0.00%
DRADS	0	40	100%	0.00%
DWQPL	0	7	100%	0.00%
E130.2 SM2340C	7	7	100%	100.00%
E300.0	34	34	100%	100.00%
E310	12	26	100%	46.15%
E375.1	24	24	100%	100.00%
EPA 160.1	16	16	100%	100.00%
EPA 160.2	23	23	100%	100.00%
E600	18	18	100%	100.00%
IONS	6	6	100%	100.00%
METADD	0	24	100%	0.00%
METCLP	0	8	100%	0.00%
SMETCLP	0	27	100%	0.00%
SW-846 6010	6	6	100%	100.00%
TRADS	0	56	100%	0.00%
USGA/ALTER	1	3	100%	33.33%

Table B23
Samples Without Surrogates

Method	Number of Samples with Surrogates	Total number of Samples	Number of Samples without Surrogates	Percent of Samples Without Surrogates
BNACLP	27	40	13	33%
PESTCLP	13	30	17	57%
EPA 524.2	23	28	5	18%
VOACLP	64	150	86	57%

Table B24
Groundwater Surrogate Results

Sample Type	Method	Cas Number	Surrogate	Minimum Recovery	Maximum Recovery	Average Recovery	QC Limits
GW	BNACLP	118-79-6	2,4,6-TRIBROMOPHENOL	37	83	65.67	10-123
GW	BNACLP	321-60-8	2-Fluorobiphenyl	65	89	76.10	43-116
GW	BNACLP	367-12-4	2-Fluorophenol	22	68	47.40	21-110
GW	BNACLP	4165-60-0	Deuterated Nitrobenzene	61	82	75.00	35-114
GW	BNACLP	4165-62-2	PHENOL-D5	18	74	46.30	10-110
GW	BNACLP	1718-51-0	p-Terphenyl-d14	46	88	69.13	33-141
GW	PESTCLP	96-12-8	1,2-Dibromo-3-Chloropropane	95	113	104.20	30-150
GW	PESTCLP	2051-24-3	DECACHLOROBIPHENYL	70	87	77.40	30-150
GW	PESTCLP	1770-80-5	DI-BUTYLCHLORENDATE	54	76	69.00	30-150
GW	VOA524.2	2199-69-1	1,2-DICHLOROBENZENE-D4	56	114	94.25	76-114
GW	VOA524.2	460-00-4	4-Bromofluorobenzene	82	114	97.50	86-115
GW	VOACLP	2199-69-1	1,2-DICHLOROBENZENE-D4	56	114	94.25	76-114
GW	VOACLP	460-00-4	4-Bromofluorobenzene	82	114	97.50	86-115
GW	VOACLP	17060-07-0	Deuterated 1,2-dichloroethane	87	114	97.71	76-114
GW	VOACLP	2037-26-5	Deuterated Toluene	88	115	103.27	88-110

Table B25
Surface Water Surrogate Results

Sample Type	Method	Cas Number	Surrogate	Minimum Recovery	Maximum Recovery	Average Recovery	QC Limits
SW	BNACLP	118-79-6	2,4,6-TRIBROMOPHENOL	66	66	66.00	10-123
SW	BNACLP	321-60-8	2-Fluorobiphenyl	52	52	52.00	43-116
SW	BNACLP	4165-60-0	Deuterated Nitrobenzene	38	38	38.00	35-114
SW	BNACLP	4165-62-2	PHENOL-D5	22	22	22.00	10-110
SW	BNACLP	SVOA-SUR3	SURROGATE 3	74	74	74.00	NA
SW	BNACLP	SVOA-SUR5	SURROGATE 5	38	38	38.00	NA
SW	PESTCLP	PEST-SUR1	PEST-SUR1	78	78	78.00	30-150
SW	VOA524.2	460-00-4	4-Bromofluorobenzene	87	109	98.43	86-115
SW	VOACLP	460-00-4	4-Bromofluorobenzene	87	109	98.43	86-115
SW	VOACLP	17060-07-0	Deuterated 1,2-dichloroethane	82	120	99.40	76-114
SW	VOACLP	2037-26-5	Deuterated Toluene	92	110	99.14	88-110

Table B26
Sediment Surrogate Results

Sample Type	Method	Cas Number	Surrogate	Minimum % Recovery	Maximum % Recovery	Average Recovery	QC Limits
SED	BNACLP	118-79-6	2,4,6-TRIBROMOPHENOL	20	120	74.38	19-122
SED	BNACLP	321-60-8	2-Fluorobiphenyl	20	94	73.50	30-115
SED	BNACLP	367-12-4	2-Fluorophenol	54	95	82.45	25-121
SED	BNACLP	4165-60-0	Deuterated Nitrobenzene	16	90	67.48	23-120
SED	BNACLP	4165-62-2	PHENOL-D5	19	102	75.52	24-113
SED	BNACLP	1718-51-0	p-Terphenyl-d14	55	131	87.83	18-137
SED	BNACLP	SVOA-SUR3	SURROGATE 3	45	104	82.67	NA
SED	BNACLP	SVOA-SUR5	SURROGATE 5	18	85	66.92	NA
SED	PESTCLP	96-12-8	1,2-Dibromo-3-Chloropropane	73	81	77.25	30-150
SED	PESTCLP	1770-80-5	DI-BUTYLCHLORENDATE	51	116	80.60	30-150
SED	PESTCLP	PEST-SUR1	PEST-SUR1	26	92	65.83	30-150
SED	VOA524.2	2199-69-1	1,2-DICHLOROBENZENE-D4	96	106	101.00	70-121
SED	VOA524.2	460-00-4	4-Bromofluorobenzene	76	102	89.89	59-113
SED	VOACLP	2199-69-1	1,2-DICHLOROBENZENE-D4	96	106	101.00	70-121
SED	VOACLP	460-00-4	4-Bromofluorobenzene	76	102	89.89	59-113
SED	VOACLP	17060-07-0	Deuterated 1,2-dichloroethane	84	105	95.15	70-121
SED	VOACLP	2037-26-5	Deuterated Toluene	99	117	105.73	84-138

Table B27
Borehole Surrogate Results

Sample Type	Method	Cas Number	Surrogate	Minimum % Recovery	Maximum % Recovery	Average Recovery	QC Limits
BH	BNACLP	118-79-6	2,4,6-TRIBROMOPHENOL	47	81	68.65	19-122
BH	BNACLP	321-60-8	2-Fluorobiphenyl	48	82	70.87	30-115
BH	BNACLP	367-12-4	2-Fluorophenol	32	65	56.13	25-121
BH	BNACLP	4165-60-0	Deuterated Nitrobenzene	50	79	65.47	23-120
BH	BNACLP	4165-62-2	PHENOL-D5	24	70	59.36	24-113
BH	BNACLP	1718-51-0	p-Terphenyl-d14	71	98	83.06	18-137
BH	VOA524.2	460-00-4	4-Bromofluorobenzene	86	102	92.11	59-113
BH	VOACLP	460-00-4	4-Bromofluorobenzene	86	102	92.11	59-113
BH	VOACLP	17060-07-0	Deuterated 1,2-dichloroethane	86	112	100.44	70-121
BH	VOACLP	2037-26-5	Deuterated Toluene	90	102	97.25	84-138

Table B28

Groundwater Validation and Verification Summary

Validation Qualifer Code	Total of CAS Numbers	BNACLP Results	DMETADD Results	Drads Results	DSMETCLP Results	DWQPL Results	SW6020 Results	METADD Results	METCLP Results	PESTCLP Results	SMETCLP Results	TRADS Results	VOA 8242 Results	VOACLP Results	WQPL Results
No V &V	1438	0	31	0	339	0	0	10	0	0	32	43	60	687	236
A	581	2	11	217	32	0	0	0	0	0	0	117	13	160	29
J	873	27	70	17	269	2	2	38	1	28	149	1	72	135	62
J1	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0
N	901	65	0	106	642	0	0	0	0	26	0	62	0	0	0
P	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R	375	2	5	26	19	0	0	1	0	0	1	20	28	262	11
V	6050	293	263	183	1106	7	3	123	0	108	194	141	1406	1620	603
V1	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Y	614	201	18	58	69	1	0	12	0	56	46	52	58	0	43
Z	105	7	0	0	0	0	0	0	0	1	0	5	2	61	29
Total	10943	597	398	607	2476	10	10	184	1	219	422	441	1639	2925	1014
Validated	9500	597	367	607	2137	10	5	174	1	219	390	398	1579	2238	778
Not Validated	1438	0	31	0	339	0	0	10	0	0	32	43	60	687	236
%Not Validated	13.14%	0.00%	7.79%	0.00%	13.69%	0.00%	0.00%	5.43%	0.00%	0.00%	7.58%	9.75%	3.66%	23.49%	23.27%
% Validated	86.81%	100.00%	92.21%	100.00%	86.31%	100.00%	50.00%	94.57%	100.00%	100.00%	92.42%	90.25%	96.34%	76.51%	76.73%
Verified	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0
% Verified	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rejected	375	2	5	26	19	0	0	1	0	0	1	20	28	262	11
% Rejected	3.43%	0.34%	1.26%	4.28%	0.77%	0.00%	0.00%	0.54%	0.00%	0.00%	0.24%	4.54%	1.71%	8.96%	1.08%

Table B29
Surface Water Validation and Verification Summary

Validation Qualifer Code	Total of CAS Numbers	ASTM D422 Results	BNA CLP Results	CLP SOW Results	DHSLMET Results	DMETADD Results	DMETCLP Results	Drads Results	DSMETCLP Results	EPA 1302 Results	EPA 1601 Results	EPA 1602 Results	EPA 3000 Results	EPA 3101 Results	EPA 376 Results	EPA 600 Results
No V &V	2085	7	133	1	0	55	0	56	436	0	0	0	0	0	0	0
1	86	0	0	79	0	0	0	0	0	0	0	0	2	0	1	1
A	343	0	1	0	0	0	0	33	85	0	0	0	0	0	0	0
J	580	0	7	20	0	27	38	8	176	0	2	1	1	0	1	0
J1	114	0	0	80	0	0	0	0	0	0	0	0	2	2	2	28
N	19	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	239	0	0	1	0	1	2	56	34	0	0	0	0	0	0	0
R1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
V	2967	7	122	76	0	62	164	25	476	1	5	6	13	8	6	0
V1	684	0	0	319	0	0	0	0	0	7	10	20	31	18	15	191
Y	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Z	75	0	0	0	27	0	0	0	0	0	0	0	0	0	0	0
UJ	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0
UJ1	0	0	0	24	0	0	0	0	0	0	0	0	1	0	0	5
Total	7287	14	263	613	27	145	204	188	1207	8	17	27	50	28	25	225
Validated	4272	7	130	108	27	90	204	132	771	1	7	7	14	8	7	0
Not Validated	2085	7	133	1	0	55	0	56	436	0	0	0	0	0	0	0
%Not Validated	28.61%	50.00%	50.57%	0.16%	0.00%	37.93%	0.00%	29.79%	36.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Validated	58.62%	50.00%	49.43%	17.62%	100.00%	62.07%	100.00%	70.21%	63.88%	12.50%	41.18%	25.93%	28.00%	28.57%	28.00%	0.00%
Verified	916	0	0	504	0	0	0	0	0	7	10	20	36	20	18	225
% Verified	12.57%	0.00%	0.00%	82.22%	0.00%	0.00%	0.00%	0.00%	0.00%	87.50%	58.82%	74.07%	72.00%	71.43%	72.00%	100.00%
Rejected	239	0	0	1	0	1	2	56	34	0	0	0	0	0	0	0
% Rejected	3.28%	0.00%	0.00%	0.16%	0.00%	0.69%	0.98%	29.79%	2.82%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table B29
Surface Water Validation and Verification Summary

HSLMET Results	Ion-t... Results	METADD Results	METCLP Results	PESTCLP Results	SMETCLP Results	TRADS Results	USGS/AL TERNATE	VOACLP Results	WQPL Results
0	0	51	0	54	393	152	14	452	288
0	0	0	0	0	0	0	3	0	0
0	0	0	0	0	95	92	0	3	34
0	0	26	58	0	117	5	7	55	31
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	9	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	4	0	29	102	0	6	3
0	0	0	0	0	0	0	0	0	0
0	0	76	172	54	535	87	42	650	387
0	6	0	0	0	0	0	67	0	0
0	0	0	0	0	23	0	0	0	14
27	0	0	0	0	0	18	0	0	3
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0
27	6	154	234	108	1193	465	133	1166	760
27	0	103	234	54	800	313	49	714	472
0	0	51	0	54	393	152	14	452	288
0.00%	0.00%	33.12%	0.00%	50.00%	32.94%	32.69%	10.53%	38.77%	37.89%
100.00%	0.00%	66.88%	100.00%	50.00%	67.06%	67.31%	36.84%	61.23%	62.11%
0	6	0	0	0	0	0	70	0	0
0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	52.63%	0.00%	0.00%
0	0	1	4	0	29	102	0	6	3
0.00%	0.00%	0.65%	1.71%	0.00%	2.43%	21.94%	0.00%	0.51%	0.39%

Table B30
Surface Soil Validation and Verification Summary

Validation Qualifier Code	Total of CAS Numbers	Alpha Spectroscopy Results	Gamma Spectroscopy Results	SW-846 6010 Results
No V &V	0	0	0	0
1	31	0	31	0
A	0	0	0	0
J	32	20	0	32
J1	35	0	0	35
N	0	0	0	0
P	0	0	0	0
R	0	0	0	0
V	85	0	0	85
V1	143	30	3	140
UJ	7	0	0	7
UJ1	11	0	0	11
Total	344	50	34	310
Total Validated	144	20	0	124
% Validated	40.00%	40.00%	0.00%	40.00%
Total Verified	250	30	34	186
% Verified	60.00%	60.00%	100.00%	60.00%
Total Rejected	0	0	0	0
% Rejected	0.00%	0.00%	0.00%	0.00%

Table B31
Sediment Validation and Verification Summary

Validation Qualifer Code	Total of CAS Numbers	BNA CLP Results	DMETADD Results	DSMETCLP Results	METADD Results	METCLP Results	PESTCLP Results	SMETCLP Results	TRADS Results	VOACLP Results	WQHL Results
No V &V	952	394	0	0	18	0	165	145	58	137	35
A	148	21	0	0	0	0	0	40	84	3	0
J	354	70	2	12	22	97	27	77	11	26	10
J1	0	0	0	0	0	0	0	0	0	0	0
N	59	0	0	0	0	0	0	26	27	0	6
P	0	0	0	0	0	0	0	0	0	0	0
R	79	12	0	0	0	0	0	12	41	14	0
V	1994	807	10	34	15	17	351	172	62	501	25
V1	0	0	0	0	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0	0	0	0	0
Z	2	0	0	0	0	0	0	0	2	0	0
Total	3588	1304	12	46	55	114	543	472	285	681	76
Total Validated	2636	910	12	46	37	114	378	327	227	544	41
Not Validated	952	394	0	0	18	0	165	145	58	137	35
%Not Validated	26.53%	30.21%	0.00%	0.00%	32.73%	0.00%	30.39%	30.72%	20.35%	20.12%	46.05%
% Validated	73.47%	69.79%	100.00%	100.00%	67.27%	100.00%	69.61%	69.28%	79.65%	79.88%	53.95%
Verified	0	0	0	0	0	0	0	0	0	0	0
% Verified	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rejected	79	12	0	0	0	0	0	12	41	14	0
% Rejected	2.20%	0.92%	0.00%	0.00%	0.00%	0.00%	0.00%	2.54%	14.39%	2.06%	0.00%

Table B32
Borehole Validation and Verification Summary

Validation Qualifer Code	Total of CAS Numbers	BNA CLP Results	METADD Results	METCLP Results	SMETSLP Results	TRADS Results	VOACLP Results	WQPL Results
No V &V	4	0	0	0	0	4	0	0
A	56	10	0	0	0	42	4	0
J	276	13	28	198	30	0	1	6
V	1126	431	7	304	131	57	181	15
Z	405	403	0	0	0	0	2	0
J	29	28	0	0	0	0	1	0
R	137	1		2		116	18	0
Total	2033	886	35	504	161	219	207	21
Total Validated	2033	886	35	504	161	219	207	21
% Validated	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Verified	0	0	0	0	0	0	0	0
% Verified	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rejected	137	1	0	2	0	116	18	0
%v Rejected	6.74%	0.11%	0.00%	0.40%	0.00%	52.97%	8.70%	0.00%

Table B33
Field Blank Detections

Blank Type	Analyte	Result	Units	Lab Qualifier	One Tenth PRG
FB	Acetone	67	ug/L	B	182500
FB	Americium-241	0.03	pCi/L		40.81
FB	Beryllium	0.1	mg/L		0.41
FB	Cadmium	3.4	ug/L		100
FB	Chromium	0.017	mg/L		304.17
FB	Iron	44	ug/L		60.83
FB	Methylene chloride	3	ug/L	JB	1012.08
FB	Molybdenum	4.6	ug/L		1010
FB	n-Nitrosodiphenylamine	6	ug/L	BJ	1549.1
FB	Plutonium-239/240	0.018	pCi/L		31.44
FB	Toluene	2	ug/L	J	40555.56
FB	Trichloroethene	2	ug/L	JB	18.98
FB	Uranium-234	23.47	pCi/L		60.03
FB	Uranium-235	0.7975	pCi/L		60.98
FB	Uranium-238	19.86	pCi/L		66.31
FB	Zinc	0.0442	mg/L		60.83
RNS	1,1,2,2-Tetrachloroethane	34	ug/L		37.95
RNS	Acetone	39	ug/L	B	18250
RNS	Aluminum	1470	ug/L		202780
RNS	Americium-241	1.345	pCi/L		40.81
RNS	Antimony	29.2	ug/L		80
RNS	Arsenic	2	ug/L	B	100
RNS	Barium	59.3	ug/L	B	14190
RNS	bis(2-Ethylhexyl)phthalate	2	ug/L	J	542.19
RNS	Cadmium	1.7	ug/L		100
RNS	Chloromethane	38	ug/L		
RNS	Chromium	25.2	ug/L		304170
RNS	Copper	38	ug/L		8110
RNS	Iron	1640	ug/L		60830
RNS	Lead	102	ug/L	W	
RNS	Lithium	0.19	ug/L	B	4060
RNS	Manganese	42.2	ug/L		28390
RNS	Methylene chloride	5	ug/L		1012.08
RNS	Plutonium-239/240	0.055	pCi/L	J	31.44
RNS	Selenium	2.9	ug/L	W	1010
RNS	Strontium	165	ug/L	B	121670
RNS	Tetrachloroethene	8	ug/L		14.06
RNS	Trichloroethene	27	ug/L		18.98
RNS	Uranium-234	83.095	pCi/L		60.03
RNS	Uranium-235	1.605	pCi/L		60.98
RNS	Uranium-238	1.306	pCi/L		66.31
RNS	Zinc	55.4	ug/L		60.83

Table B34
Trip Blank Detections

Analyte	Result	Units	Laboratory Qualifier	One Tenth RBC
Acetone	6	ug/L	JB	182500
Chloroform	2	ug/L	J	2027.78
Methylene chloride	3	ug/L	BJ	1012.08
Toluene	2	ug/L	J	40555.56
Trichloroethene	2	ug/L	JB	18.98

Table B35
Trip Blank Percentage

Number of Blanks	Number Trip Blanks	Percentage	Required
29	4	13.79%	5%

Table B36
Method Blank Detections

Analyte	Result	Units	Laboratory Qualifier	Organic PRG
Aluminum	23.9	ug/L		202780
Antimony	2	ug/L	B	80
Arsenic	0	ug/L	B	10
Barium	0.92	ug/L	B	14190
Beryllium	0.29	ug/L	B	410
Cadmium	0.41	ug/L	B	100
Chromium	0.809	ug/L	B	304170
Cobalt	0.74	ug/L	B	406
Copper	0.46	ug/L		8110
Iron	17.5	ug/L	B	60830
Lead	1	ug/L	B	0
Lithium	2.3	ug/L	B	4060
Manganese	0.228	ug/L	B	28390
Mercury	-0.1	ug/L		60
Nickel	7.5	ug/L	B	4060
Silver	0.077	ug/L	B	1010
Strontium	0.47	ug/L	B	0
Tin	3.8	ug/L	B	121670
Vanadium	11.2	ug/L	B	200
Zinc	24.5	ug/L		60830

Table B37
Maximum Detection and Reporting Limits for Semivolatile Organic Compounds

Method Name	Sample Type	Analyte	Result	Units	Lab Qualifier	Detection Limit	PRG	Units
BNACLP	BH	1,2,4-Trichlorobenzene	10	ug/L	U	10	20277.78	ug/L
BNACLP	GW	1,2,4-Trichlorobenzene	10	ug/L	U	10	20277.78	ug/L
BNACLP	SW	1,2,4-Trichlorobenzene	10	ug/L	U	10	20277.78	ug/L
BNACLP	BH	2,4,5-Trichlorophenol	50	ug/L	U	50	202777.78	ug/L
BNACLP	GW	2,4,5-Trichlorophenol	50	ug/L	U	50	202777.78	ug/L
BNACLP	SW	2,4,5-Trichlorophenol	50	ug/L	U	50	202777.78	ug/L
BNACLP	BH	2,4,6-Trichlorophenol	10	ug/L	U	10	6900.56	ug/L
BNACLP	GW	2,4,6-Trichlorophenol	10	ug/L	U	10	6900.56	ug/L
BNACLP	SW	2,4,6-Trichlorophenol	10	ug/L	U	10	6900.56	ug/L
BNACLP	BH	2,4-Dichlorophenol	10	ug/L	U	10	6083.33	ug/L
BNACLP	GW	2,4-Dichlorophenol	10	ug/L	U	10	6083.33	ug/L
BNACLP	SW	2,4-Dichlorophenol	10	ug/L	U	10	6083.33	ug/L
BNACLP	BH	2,4-Dimethylphenol	10	ug/L	U	10	40555.56	ug/L
BNACLP	GW	2,4-Dimethylphenol	10	ug/L	U	10	40555.56	ug/L
BNACLP	SW	2,4-Dimethylphenol	10	ug/L	U	10	40555.56	ug/L
BNACLP	BH	2,4-Dinitrophenol	50	ug/L	U	50	4055.56	ug/L
BNACLP	GW	2,4-Dinitrophenol	50	ug/L	U	50	4055.56	ug/L
BNACLP	SW	2,4-Dinitrophenol	50	ug/L	U	50	4055.56	ug/L
BNACLP	BH	2,4-Dinitrotoluene	10	ug/L	U	10	4055.56	ug/L
BNACLP	GW	2,4-Dinitrotoluene	10	ug/L	U	10	4055.56	ug/L
BNACLP	SW	2,4-Dinitrotoluene	10	ug/L	U	10	4055.56	ug/L
BNACLP	BH	2,6-Dinitrotoluene	10	ug/L	U	10	2027.78	ug/L
BNACLP	GW	2,6-Dinitrotoluene	10	ug/L	U	10	2027.78	ug/L
BNACLP	SW	2,6-Dinitrotoluene	10	ug/L	U	10	2027.78	ug/L
BNACLP	BH	2-Chloronaphthalene	10	ug/L	U	10	162222.22	ug/L
BNACLP	GW	2-Chloronaphthalene	10	ug/L	U	10	162222.22	ug/L
BNACLP	SW	2-Chloronaphthalene	10	ug/L	U	10	162222.22	ug/L
BNACLP	BH	2-Chlorophenol	10	ug/L	U	10	10138.89	ug/L
BNACLP	GW	2-Chlorophenol	10	ug/L	U	10	10138.89	ug/L
BNACLP	SW	2-Chlorophenol	10	ug/L	U	10	10138.89	ug/L
BNACLP	BH	2-Methylnaphthalene	10	ug/L	U	10	8111.11	ug/L
BNACLP	GW	2-Methylnaphthalene	10	ug/L	U	10	8111.11	ug/L
BNACLP	SW	2-Methylnaphthalene	10	ug/L	U	10	8111.11	ug/L
BNACLP	BH	2-Nitroaniline	50	ug/L	U	50	6083.33	ug/L
BNACLP	GW	2-Nitroaniline	50	ug/L	U	50	6083.33	ug/L
BNACLP	SW	2-Nitroaniline	50	ug/L	U	50	6083.33	ug/L
BNACLP	BH	4-Chloro-3-methylphenol	10	ug/L	U	10		ug/L
BNACLP	GW	4-Chloro-3-methylphenol	10	ug/L	U	10		ug/L
BNACLP	SW	4-Chloro-3-methylphenol	10	ug/L	U	10		ug/L
BNACLP	BH	4-Chloroaniline	10	ug/L	U	10	8111.11	ug/L
BNACLP	GW	4-Chloroaniline	10	ug/L	U	10	8111.11	ug/L
BNACLP	SW	4-Chloroaniline	10	ug/L	U	10	8111.11	ug/L
BNACLP	BH	4-Nitrophenol	50	ug/L	U	50	16222.22	ug/L
BNACLP	GW	4-Nitrophenol	50	ug/L	U	50	16222.22	ug/L
BNACLP	SW	4-Nitrophenol	50	ug/L	U	50	16222.22	ug/L
BNACLP	BH	Acenaphthene	10	ug/L	U	10	121666.67	ug/L
BNACLP	GW	Acenaphthene	10	ug/L	U	10	121666.67	ug/L
BNACLP	SW	Acenaphthene	10	ug/L	U	10	121666.67	ug/L
BNACLP	BH	Acenaphthylene	10	ug/L	U	10		ug/L
BNACLP	GW	Acenaphthylene	10	ug/L	U	10		ug/L
BNACLP	SW	Acenaphthylene	10	ug/L	U	10		ug/L

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Table B37
Maximum Detection and Reporting Limits for Semivolatile Organic Compounds

Method Name	Sample Type	Analyte	Result	Units	Lab Qualifier	Detection Limit	PRG	Units
BNACLP	BH	Anthracene	10	ug/L	U	10	608333.33	ug/L
BNACLP	GW	Anthracene	10	ug/L	U	10	608333.33	ug/L
BNACLP	SW	Anthracene	10	ug/L	U	10	608333.33	ug/L
BNACLP	BH	Benzo(a)anthracene	10	ug/L	U	10	103.98	ug/L
BNACLP	GW	Benzo(a)anthracene	10	ug/L	U	10	103.98	ug/L
BNACLP	SW	Benzo(a)anthracene	10	ug/L	U	10	103.98	ug/L
BNACLP	BH	Benzo(a)pyrene	10	ug/L	U	10	10.40	ug/L
BNACLP	GW	Benzo(a)pyrene	10	ug/L	U	10	10.40	ug/L
BNACLP	SW	Benzo(a)pyrene	10	ug/L	U	10	10.40	ug/L
BNACLP	BH	Benzo(b)fluoranthene	10	ug/L	U	10	103.98	ug/L
BNACLP	GW	Benzo(b)fluoranthene	10	ug/L	U	10	103.98	ug/L
BNACLP	SW	Benzo(b)fluoranthene	10	ug/L	U	10	103.98	ug/L
BNACLP	BH	Benzo(k)fluoranthene	10	ug/L	U	10	1039.81	ug/L
BNACLP	GW	Benzo(k)fluoranthene	10	ug/L	U	10	1039.81	ug/L
BNACLP	SW	Benzo(k)fluoranthene	10	ug/L	U	10	1039.81	ug/L
BNACLP	BH	Benzyl Alcohol	10	ug/L	U	10	608333.33	ug/L
BNACLP	GW	Benzyl Alcohol	10	ug/L	U	10	608333.33	ug/L
BNACLP	SW	Benzyl Alcohol	10	ug/L	U	10	608333.33	ug/L
BNACLP	BH	bis(2-Chloroethyl)ether	10	ug/L	U	10	69.01	ug/L
BNACLP	GW	bis(2-Chloroethyl)ether	10	ug/L	U	10	69.01	ug/L
BNACLP	SW	bis(2-Chloroethyl)ether	10	ug/L	U	10	69.01	ug/L
BNACLP	BH	bis(2-Chloroisopropyl)ether	10	ug/L	U	10	1084.37	ug/L
BNACLP	GW	bis(2-Chloroisopropyl)ether	10	ug/L	U	10	1084.37	ug/L
BNACLP	SW	bis(2-Chloroisopropyl)ether	10	ug/L	U	10	1084.37	ug/L
BNACLP	BH	bis(2-Ethylhexyl)phthalate	10	ug/L	U	10	5421.87	ug/L
BNACLP	GW	bis(2-Ethylhexyl)phthalate	10	ug/L	U	10	5421.87	ug/L
BNACLP	SW	bis(2-Ethylhexyl)phthalate	10	ug/L	U	10	5421.87	ug/L
BNACLP	BH	Butylbenzylphthalate	10	ug/L	U	10	405555.56	ug/L
BNACLP	GW	Butylbenzylphthalate	10	ug/L	U	10	405555.56	ug/L
BNACLP	SW	Butylbenzylphthalate	10	ug/L	U	10	405555.56	ug/L
BNACLP	BH	Chrysene	10	ug/L	U	10	10398.10	ug/L
BNACLP	GW	Chrysene	10	ug/L	U	10	10398.10	ug/L
BNACLP	SW	Chrysene	10	ug/L	U	10	10398.10	ug/L
BNACLP	BH	Dibenzofuran	10	ug/L	U	10	4055.56	ug/L
BNACLP	GW	Dibenzofuran	10	ug/L	U	10	4055.56	ug/L
BNACLP	SW	Dibenzofuran	10	ug/L	U	10	4055.56	ug/L
BNACLP	BH	Diethylphthalate	10	ug/L	U	10	1622222.22	ug/L
BNACLP	GW	Diethylphthalate	10	ug/L	U	10	1622222.22	ug/L
BNACLP	SW	Diethylphthalate	10	ug/L	U	10	1622222.22	ug/L
BNACLP	BH	Dimethylphthalate	10	ug/L	U	10	20277777.78	ug/L
BNACLP	GW	Dimethylphthalate	10	ug/L	U	10	20277777.78	ug/L
BNACLP	SW	Dimethylphthalate	10	ug/L	U	10	20277777.78	ug/L
BNACLP	BH	Di-n-butylphthalate	10	ug/L	U	10	202777.78	ug/L
BNACLP	GW	Di-n-butylphthalate	10	ug/L	U	10	202777.78	ug/L
BNACLP	SW	Di-n-butylphthalate	10	ug/L	U	10	202777.78	ug/L
BNACLP	BH	Di-n-octylphthalate	10	ug/L	U	10	81111.11	ug/L
BNACLP	GW	Di-n-octylphthalate	10	ug/L	U	10	81111.11	ug/L
BNACLP	SW	Di-n-octylphthalate	10	ug/L	U	10	81111.11	ug/L
BNACLP	BH	Fluoranthene	10	ug/L	U	10	81111.11	ug/L
BNACLP	GW	Fluoranthene	10	ug/L	U	10	81111.11	ug/L
BNACLP	SW	Fluoranthene	10	ug/L	U	10	81111.11	ug/L

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Table B37
Maximum Detection and Reporting Limits for Semivolatile Organic Compounds

Method Name	Sample Type	Analyte	Result	Units	Lab Qualifier	Detection Limit	PRG	Units
BNACLP	BH	Fluorene	10	ug/L	U	10	81111.11	ug/L
BNACLP	GW	Fluorene	10	ug/L	U	10	81111.11	ug/L
BNACLP	SW	Fluorene	10	ug/L	U	10	81111.11	ug/L
BNACLP	BH	Hexachlorobenzene	10	ug/L	U	10	47.44	ug/L
BNACLP	GW	Hexachlorobenzene	10	ug/L	U	10	47.44	ug/L
BNACLP	SW	Hexachlorobenzene	10	ug/L	U	10	47.44	ug/L
BNACLP	BH	Hexachlorobutadiene	10	ug/L	U	10	405.56	ug/L
BNACLP	GW	Hexachlorobutadiene	10	ug/L	U	10	405.56	ug/L
BNACLP	SW	Hexachlorobutadiene	10	ug/L	U	10	405.56	ug/L
BNACLP	BH	Hexachlorocyclopentadiene	10	ug/L	U	10	12166.67	ug/L
BNACLP	GW	Hexachlorocyclopentadiene	10	ug/L	U	10	12166.67	ug/L
BNACLP	SW	Hexachlorocyclopentadiene	10	ug/L	U	10	12166.67	ug/L
BNACLP	BH	Hexachloroethane	10	ug/L	U	10	2027.78	ug/L
BNACLP	GW	Hexachloroethane	10	ug/L	U	10	2027.78	ug/L
BNACLP	SW	Hexachloroethane	10	ug/L	U	10	2027.78	ug/L
BNACLP	BH	Indeno(1,2,3-cd)pyrene	10	ug/L	U	10	103.98	ug/L
BNACLP	GW	Indeno(1,2,3-cd)pyrene	10	ug/L	U	10	103.98	ug/L
BNACLP	SW	Indeno(1,2,3-cd)pyrene	10	ug/L	U	10	103.98	ug/L
BNACLP	BH	Isophorone	10	ug/L	U	10	79901.18	ug/L
BNACLP	GW	Isophorone	10	ug/L	U	10	79901.18	ug/L
BNACLP	SW	Isophorone	10	ug/L	U	10	79901.18	ug/L
BNACLP	BH	Naphthalene	10	ug/L	U	10	40555.56	ug/L
BNACLP	GW	Naphthalene	10	ug/L	U	10	40555.56	ug/L
BNACLP	SW	Naphthalene	10	ug/L	U	10	40555.56	ug/L
BNACLP	BH	Nitrobenzene	10	ug/L	U	10	1013.89	ug/L
BNACLP	GW	Nitrobenzene	10	ug/L	U	10	1013.89	ug/L
BNACLP	SW	Nitrobenzene	10	ug/L	U	10	1013.89	ug/L
BNACLP	BH	n-Nitrosodiphenylamine	10	ug/L	U	10	15491.04	ug/L
BNACLP	SW	n-Nitrosodiphenylamine	10	ug/L	U	10	15491.04	ug/L
BNACLP	BH	Pentachlorophenol	50	ug/L	U	50	632.55	ug/L
BNACLP	GW	Pentachlorophenol	50	ug/L	U	50	632.55	ug/L
BNACLP	SW	Pentachlorophenol	50	ug/L	U	50	632.55	ug/L
BNACLP	BH	Phenanthrene	10	ug/L	U	10		ug/L
BNACLP	GW	Phenanthrene	10	ug/L	U	10		ug/L
BNACLP	SW	Phenanthrene	10	ug/L	U	10		ug/L
BNACLP	BH	Phenol	10	ug/L	U	10	608333.33	ug/L
BNACLP	GW	Phenol	10	ug/L	U	10	608333.33	ug/L
BNACLP	SW	Phenol	10	ug/L	U	10	608333.33	ug/L
BNACLP	BH	Pyrene	10	ug/L	U	10	60833.33	ug/L
BNACLP	GW	Pyrene	10	ug/L	U	10	60833.33	ug/L
BNACLP	SW	Pyrene	10	ug/L	U	10	60833.33	ug/L

Table B38
Maximum Detection and Reporting Limits for Volatile Organic Compounds

Method Name	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
VOACLP	BH	1,1,1-Trichloroethane	5	ug/L	U	5	567777.78	ug/L
VOACLP	GW	1,1,1-Trichloroethane	5	ug/L	U	5	567777.78	ug/L
VOACLP	SW	1,1,1-Trichloroethane	5	ug/L	U	5	567777.78	ug/L
VOACLP	WQ	1,1,1-Trichloroethane	5	ug/L	U	5	567777.78	ug/L
VOACLP	SW	1,1,1-Trichloroethane	5	ug/L	U	5	567777.78	ug/L
VOACLP	BH	1,1,2,2-Tetrachloroethane	5	ug/L	U	5	379.53	ug/L
VOACLP	GW	1,1,2,2-Tetrachloroethane	5	ug/L	U	5	379.53	ug/L
VOACLP	SW	1,1,2,2-Tetrachloroethane	5	ug/L	U	5	379.53	ug/L
VOACLP	WQ	1,1,2,2-Tetrachloroethane	5	ug/L	U	5	379.53	ug/L
VOACLP	SW	1,1,2,2-Tetrachloroethane	5	ug/L	U	5	379.53	ug/L
VOACLP	BH	1,1,2-Trichloroethane	5	ug/L	U	5	1331.69	ug/L
VOACLP	GW	1,1,2-Trichloroethane	5	ug/L	U	5	1331.69	ug/L
VOACLP	SW	1,1,2-Trichloroethane	5	ug/L	U	5	1331.69	ug/L
VOACLP	WQ	1,1,2-Trichloroethane	5	ug/L	U	5	1331.69	ug/L
VOACLP	SW	1,1,2-Trichloroethane	5	ug/L	U	5	1331.69	ug/L
VOACLP	BH	1,1-Dichloroethane	5	ug/L	U	5	202777.78	ug/L
VOACLP	GW	1,1-Dichloroethane	5	ug/L	U	5	202777.78	ug/L
VOACLP	SW	1,1-Dichloroethane	5	ug/L	U	5	202777.78	ug/L
VOACLP	WQ	1,1-Dichloroethane	5	ug/L	U	5	202777.78	ug/L
VOACLP	SW	1,1-Dichloroethane	5	ug/L	U	5	202777.78	ug/L
VOACLP	BH	1,1-Dichloroethene	5	ug/L	U	5	101388.89	ug/L
VOACLP	GW	1,1-Dichloroethene	5	ug/L	UJ	5	101388.89	ug/L
VOACLP	SW	1,1-Dichloroethene	5	ug/L	U	5	101388.89	ug/L
VOACLP	WQ	1,1-Dichloroethene	5	ug/L	U	5	101388.89	ug/L
VOACLP	SW	1,1-Dichloroethene	5	ug/L	U	5	101388.89	ug/L
VOACLP	BH	1,2-Dichloroethane	5	ug/L	U	5	834.13	ug/L
VOACLP	GW	1,2-Dichloroethane	5	ug/L	U	5	834.13	ug/L
VOACLP	SW	1,2-Dichloroethane	5	ug/L	U	5	834.13	ug/L
VOACLP	WQ	1,2-Dichloroethane	5	ug/L	U	5	834.13	ug/L
VOACLP	SW	1,2-Dichloroethane	5	ug/L	U	5	834.13	ug/L
VOACLP	BH	1,2-Dichloroethene (total)	5	ug/L	U	5	18250.00	ug/L
VOACLP	GW	1,2-Dichloroethene (total)	5	ug/L	U	5	18250.00	ug/L
VOACLP	SW	1,2-Dichloroethene (total)	5	ug/L	U	5	18250.00	ug/L
VOACLP	WQ	1,2-Dichloroethene (total)	5	ug/L	U	5	18250.00	ug/L
VOACLP	SW	1,2-Dichloroethene (total)	5	ug/L	U	5	18250.00	ug/L
VOACLP	BH	1,2-Dichloropropane	5	ug/L	U	5	1116.27	ug/L
VOACLP	GW	1,2-Dichloropropane	5	ug/L	U	5	1116.27	ug/L
VOACLP	SW	1,2-Dichloropropane	5	ug/L	U	5	1116.27	ug/L
VOACLP	WQ	1,2-Dichloropropane	5	ug/L	U	5	1116.27	ug/L
VOACLP	SW	1,2-Dichloropropane	5	ug/L	U	5	1116.27	ug/L
VOACLP	BH	Acetone	10	ug/L	U	10	1825000.00	ug/L
VOACLP	GW	Acetone	10	ug/L	U	10	1825000.00	ug/L
VOACLP	SW	Acetone	13	ug/L	U	10	1825000.00	ug/L
VOACLP	WQ	Acetone	10	ug/L	U	10	1825000.00	ug/L
VOACLP	SW	Acetone	10	ug/L	U	10	1825000.00	ug/L
VOACLP	BH	Benzene	5	ug/L	U	5	1380.11	ug/L
VOACLP	GW	Benzene	5	ug/L	U	5	1380.11	ug/L
VOACLP	SW	Benzene	5	ug/L	U	5	1380.11	ug/L
VOACLP	WQ	Benzene	5	ug/L	U	5	1380.11	ug/L
VOACLP	SW	Benzene	5	ug/L	U	5	1380.11	ug/L
VOACLP	BH	Bromodichloromethane	5	ug/L	U	5	1224.29	ug/L
VOACLP	GW	Bromodichloromethane	5	ug/L	U	5	1224.29	ug/L

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Table B38
Maximum Detection and Reporting Limits for Volatile Organic Compounds

Method Name	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
VOACLP	SW	Bromodichloromethane	5	ug/L	U	5	1224.29	ug/L
VOACLP	WQ	Bromodichloromethane	5	ug/L	U	5	1224.29	ug/L
VOACLP	SW	Bromodichloromethane	5	ug/L	U	5	1224.29	ug/L
VOACLP	BH	Bromoform	5	ug/L	U	5	9608.37	ug/L
VOACLP	GW	Bromoform	5	ug/L	U	5	9608.37	ug/L
VOACLP	SW	Bromoform	5	ug/L	U	5	9608.37	ug/L
VOACLP	WQ	Bromoform	5	ug/L	U	5	9608.37	ug/L
VOACLP	SW	Bromoform	5	ug/L	U	5	9608.37	ug/L
VOACLP	BH	Carbon Disulfide	5	ug/L	U	5	202777.78	ug/L
VOACLP	GW	Carbon Disulfide	5	ug/L	U	5	202777.78	ug/L
VOACLP	SW	Carbon Disulfide	5	ug/L	U	5	202777.78	ug/L
VOACLP	WQ	Carbon Disulfide	5	ug/L	U	5	202777.78	ug/L
VOACLP	SW	Carbon Disulfide	5	ug/L	U	5	202777.78	ug/L
VOACLP	BH	Carbon Tetrachloride	5	ug/L	U	5	583.89	ug/L
VOACLP	GW	Carbon Tetrachloride	5	ug/L	U	5	583.89	ug/L
VOACLP	SW	Carbon Tetrachloride	5	ug/L	U	5	583.89	ug/L
VOACLP	WQ	Carbon Tetrachloride	5	ug/L	U	5	583.89	ug/L
VOACLP	SW	Carbon Tetrachloride	5	ug/L	U	5	583.89	ug/L
VOACLP	BH	Chlorobenzene	5	ug/L	U	5	40555.56	ug/L
VOACLP	GW	Chlorobenzene	5	ug/L	U	5	40555.56	ug/L
VOACLP	SW	Chlorobenzene	5	ug/L	U	5	40555.56	ug/L
VOACLP	WQ	Chlorobenzene	5	ug/L	U	5	40555.56	ug/L
VOACLP	SW	Chlorobenzene	5	ug/L	U	5	40555.56	ug/L
VOACLP	BH	Chloroform	5	ug/L	U	5	20277.78	ug/L
VOACLP	GW	Chloroform	5	ug/L	U	5	20277.78	ug/L
VOACLP	SW	Chloroform	5	ug/L	U	5	20277.78	ug/L
VOACLP	WQ	Chloroform	5	ug/L	U	5	20277.78	ug/L
VOACLP	SW	Chloroform	5	ug/L	U	5	20277.78	ug/L
VOACLP	BH	cis-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	GW	cis-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	SW	cis-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	WQ	cis-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	SW	cis-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	BH	Dibromochloromethane	5	ug/L	U	5	903.64	ug/L
VOACLP	GW	Dibromochloromethane	5	ug/L	U	5	903.64	ug/L
VOACLP	GW	Dibromochloromethane	5	ug/L	UJ	5	903.64	ug/L
VOACLP	SW	Dibromochloromethane	5	ug/L	U	5	903.64	ug/L
VOACLP	WQ	Dibromochloromethane	5	ug/L	U	5	903.64	ug/L
VOACLP	SW	Dibromochloromethane	5	ug/L	U	5	903.64	ug/L
VOACLP	BH	Ethylbenzene	5	ug/L	U	5	202777.78	ug/L
VOACLP	GW	Ethylbenzene	5	ug/L	U	5	202777.78	ug/L
VOACLP	SW	Ethylbenzene	5	ug/L	U	5	202777.78	ug/L
VOACLP	WQ	Ethylbenzene	5	ug/L	U	5	202777.78	ug/L
VOACLP	SW	Ethylbenzene	5	ug/L	U	5	202777.78	ug/L
VOACLP	BH	Tetrachloroethene	5	ug/L	U	5	140.57	ug/L
VOACLP	GW	Tetrachloroethene	5	ug/L	U	5	140.57	ug/L
VOACLP	SW	Tetrachloroethene	5	ug/L	U	5	140.57	ug/L
VOACLP	WQ	Tetrachloroethene	5	ug/L	U	5	140.57	ug/L
VOACLP	SW	Tetrachloroethene	5	ug/L	U	5	140.57	ug/L
VOACLP	BH	Toluene	5	ug/L	U	5	405555.56	ug/L
VOACLP	GW	Toluene	5	ug/L	U	5	405555.56	ug/L
VOACLP	SW	Toluene	5	ug/L	U	5	405555.56	ug/L

Table B38
Maximum Detection and Reporting Limits for Volatile Organic Compounds

Method Name	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
VOACLP	WQ	Toluene	5	ug/L	U	5	405555.56	ug/L
VOACLP	SW	Toluene	5	ug/L	U	5	405555.56	ug/L
VOACLP	BH	trans-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	GW	trans-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	SW	trans-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	WQ	trans-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	SW	trans-1,3-Dichloropropene	5	ug/L	U	5	759.06	ug/L
VOACLP	BH	Trichloroethene	5	ug/L	U	5	189.77	ug/L
VOACLP	GW	Trichloroethene	5	ug/L	U	5	189.77	ug/L
VOACLP	SW	Trichloroethene	5	ug/L	U	5	189.77	ug/L
VOACLP	WQ	Trichloroethene	5	ug/L	U	5	189.77	ug/L
VOACLP	SW	Trichloroethene	5	ug/L	U	5	189.77	ug/L
VOACLP	BH	Vinyl acetate	10	ug/L	U	10	2027777.78	ug/L
VOACLP	GW	Vinyl acetate	10	ug/L	U	10	2027777.78	ug/L
VOACLP	SW	Vinyl acetate	10	ug/L	U	10	2027777.78	ug/L
VOACLP	WQ	Vinyl acetate	10	ug/L	U	10	2027777.78	ug/L
VOACLP	SW	Vinyl acetate	10	ug/L	U	10	2027777.78	ug/L
VOACLP	BH	Vinyl chloride	10	ug/L	U	10	50.60	ug/L
VOACLP	GW	Vinyl chloride	10	ug/L	U	10	50.60	ug/L
VOACLP	SW	Vinyl chloride	10	ug/L	U	10	50.60	ug/L
VOACLP	WQ	Vinyl chloride	10	ug/L	U	10	50.60	ug/L
VOACLP	SW	Vinyl chloride	10	ug/L	U	10	50.60	ug/L

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Table B39

Maximum Detection and Reporting Limits for Pesticide Analysis

Test/Method	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
PESTCLP	GW	Aldrin	0.05	ug/L	U	0.05	4.47	ug/L
PESTCLP	SW	Aldrin	0.051	ug/L	U	0.051	4.47	ug/L
PESTCLP	SW	Aldrin	0.054	ug/L	U	0.054	4.47	ug/L
PESTCLP	SW	beta-Chlordane	0.51	ug/L	U	0.51	216.87	ug/L
PESTCLP	SW	beta-Chlordane	0.54	ug/L	U	0.54	216.87	ug/L
PESTCLP	GW	Dieldrin	0.1	ug/L	U	0.1	4.74	ug/L
PESTCLP	SW	Dieldrin	0.1	ug/L	U	0.1	4.74	ug/L
PESTCLP	SW	Dieldrin	0.11	ug/L	U	0.11	4.74	ug/L
PESTCLP	GW	Endosulfan I	0.05	ug/L	U	0.05	12166.67	ug/L
PESTCLP	SW	Endosulfan I	0.051	ug/L	U	0.051	12166.67	ug/L
PESTCLP	SW	Endosulfan I	0.054	ug/L	U	0.054	12166.67	ug/L
PESTCLP	GW	Endosulfan II	0.1	ug/L	U	0.1	12166.67	ug/L
PESTCLP	SW	Endosulfan II	0.1	ug/L	U	0.1	12166.67	ug/L
PESTCLP	SW	Endosulfan II	0.11	ug/L	U	0.11	12166.67	ug/L
PESTCLP	GW	Endosulfan sulfate	0.1	ug/L	U	0.1	12166.67	ug/L
PESTCLP	SW	Endosulfan sulfate	0.1	ug/L	U	0.1	12166.67	ug/L
PESTCLP	SW	Endosulfan sulfate	0.11	ug/L	U	0.11	12166.67	ug/L
PESTCLP	GW	ENDRIN KETONE	0.1	ug/L	U	0.1	608.33	ug/L
PESTCLP	SW	ENDRIN KETONE	0.1	ug/L	U	0.1	608.33	ug/L
PESTCLP	SW	ENDRIN KETONE	0.11	ug/L	U	0.11	608.33	ug/L
PESTCLP	GW	Heptachlor	0.05	ug/L	U	0.05	16.87	ug/L
PESTCLP	SW	Heptachlor	0.051	ug/L	U	0.051	16.87	ug/L
PESTCLP	SW	Heptachlor	0.054	ug/L	U	0.054	16.87	ug/L
PESTCLP	GW	Heptachlor epoxide	0.05	ug/L	U	0.05	8.34	ug/L
PESTCLP	SW	Heptachlor epoxide	0.051	ug/L	U	0.051	8.34	ug/L
PESTCLP	SW	Heptachlor epoxide	0.054	ug/L	U	0.054	8.34	ug/L
PESTCLP	GW	Methoxychlor	0.5	ug/L	U	0.5	10138.89	ug/L
PESTCLP	SW	Methoxychlor	0.51	ug/L	U	0.51	10138.89	ug/L
PESTCLP	SW	Methoxychlor	0.54	ug/L	U	0.54	10138.89	ug/L
PESTCLP	GW	Toxaphene	1	ug/L	U	1	69.01	ug/L
PESTCLP	SW	Toxaphene	1	ug/L	U	1	69.01	ug/L
PESTCLP	SW	Toxaphene	1.1	ug/L	U	1.1	69.01	ug/L

Table B40
Maximum Detection and Reporting Limits for Total Metals

Method Name	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
SMETCLP	SW	Aluminum	0.2	mg/L	U	200	2027.78	mg/L
SMETCLP	SW	Antimony	0.06	mg/L	U	60	0.81	mg/L
SMETCLP	SW	Arsenic	0.01	mg/L	U	10	0.05	mg/L
SMETCLP	SW	Barium	0.2	mg/L	U	200	141.94	mg/L
SMETCLP	SW	Beryllium	0.005	mg/L	U	5	4.06	mg/L
SMETCLP	SW	Cadmium	0.005	mg/L	U	5	1.01	mg/L
SMETCLP	SW	Chromium	0.01	mg/L	U	10	3041.67	mg/L
SMETCLP	SW	Cobalt	0.05	mg/L	U	50	40.56	mg/L
SMETCLP	SW	Copper	0.025	mg/L	U	25	81.11	mg/L
SMETCLP	SW	Iron	0.1	mg/L	U	100	608.33	mg/L
SMETCLP	SW	Lead	0.003	mg/L	U	3		mg/L
SMETCLP	SW	Lead	0.005	mg/L	U	5		mg/L
SMETCLP	SW	Lithium	0.1	mg/L	U	100	40.56	mg/L
SMETCLP	SW	Mercury	0.0002	mg/L	U	0.2	0.61	mg/L
SMETCLP	SW	Molybdenum	0.1	mg/L	U	100	10.14	mg/L
SMETCLP	SW	Selenium	0.005	mg/L	U	5	10.14	mg/L
SMETCLP	SW	Silver	0.01	mg/L	U	10	10.14	mg/L
SMETCLP	SW	Strontium	0.1	mg/L	U	100	1216.67	mg/L
SMETCLP	SW	Strontium	1	mg/L	U	1000	1216.67	mg/L
SMETCLP	SW	Thallium	0.01	mg/L	U	10	0.14	mg/L
SMETCLP	SW	Tin	0.1	mg/L	U	100	1216.67	mg/L
SMETCLP	SW	Vanadium	0.05	mg/L	U	50	2.03	mg/L
SMETCLP	SW	Zinc	0.02	mg/L	U	20	608.33	mg/L

Table B41

Maximum Detection and Reporting Limits for Dissolved Metals

Method Name	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
DSMETCLP	SW	Aluminum	0.2	mg/L	U	200	2027.78	mg/L
DSMETCLP	SW	Antimony	0.06	mg/L	U	60	0.81	mg/L
DSMETCLP	GW	Arsenic	0.01	mg/L	U	0.01	0.05	mg/L
DSMETCLP	SW	Arsenic	0.01	mg/L	U	10	0.05	mg/L
DSMETCLP	SW	Barium	0.2	mg/L	U	200	141.94	mg/L
DSMETCLP	SW	Beryllium	0.005	mg/L	U	5	4.06	mg/L
DSMETCLP	SW	Cadmium	0.005	mg/L	U	5	1.01	mg/L
DSMETCLP	SW	Chromium	0.01	mg/L	U	10	3041.67	mg/L
DSMETCLP	SW	Cobalt	0.05	mg/L	U	50	40.56	mg/L
DSMETCLP	SW	Copper	0.025	mg/L	U	25	81.11	mg/L
DSMETCLP	SW	Iron	0.1	mg/L	U	100	608.33	mg/L
DSMETCLP	GW	Lead	0.005	mg/L	U	0.005		mg/L
DSMETCLP	SW	Lead	0.003	mg/L	U	3		mg/L
DSMETCLP	SW	Lead	0.005	mg/L	U	5		mg/L
DSMETCLP	SW	Lithium	0.1	mg/L	U	100	40.56	mg/L
DSMETCLP	SW	Mercury	0.0002	mg/L	U	0.2	0.61	mg/L
DSMETCLP	SW	Molybdenum	0.1	mg/L	U	100	10.14	mg/L
DSMETCLP	GW	Selenium	0.005	mg/L	U	0.005	10.14	mg/L
DSMETCLP	SW	Selenium	0.005	mg/L	U	5	10.14	mg/L
DSMETCLP	SW	Silver	0.01	mg/L	U	10	10.14	mg/L
DSMETCLP	SW	Strontium	0.1	mg/L	U	100	1216.67	mg/L
DSMETCLP	SW	Strontium	1	mg/L	U	1000	1216.67	mg/L
DSMETCLP	GW	Thallium	0.01	mg/L	U	0.01	0.14	mg/L
DSMETCLP	SW	Thallium	0.01	mg/L	U	10	0.14	mg/L
DSMETCLP	SW	Tin	0.1	mg/L	U	100	1216.67	mg/L
DSMETCLP	SW	Vanadium	0.05	mg/L	U	50	2.03	mg/L

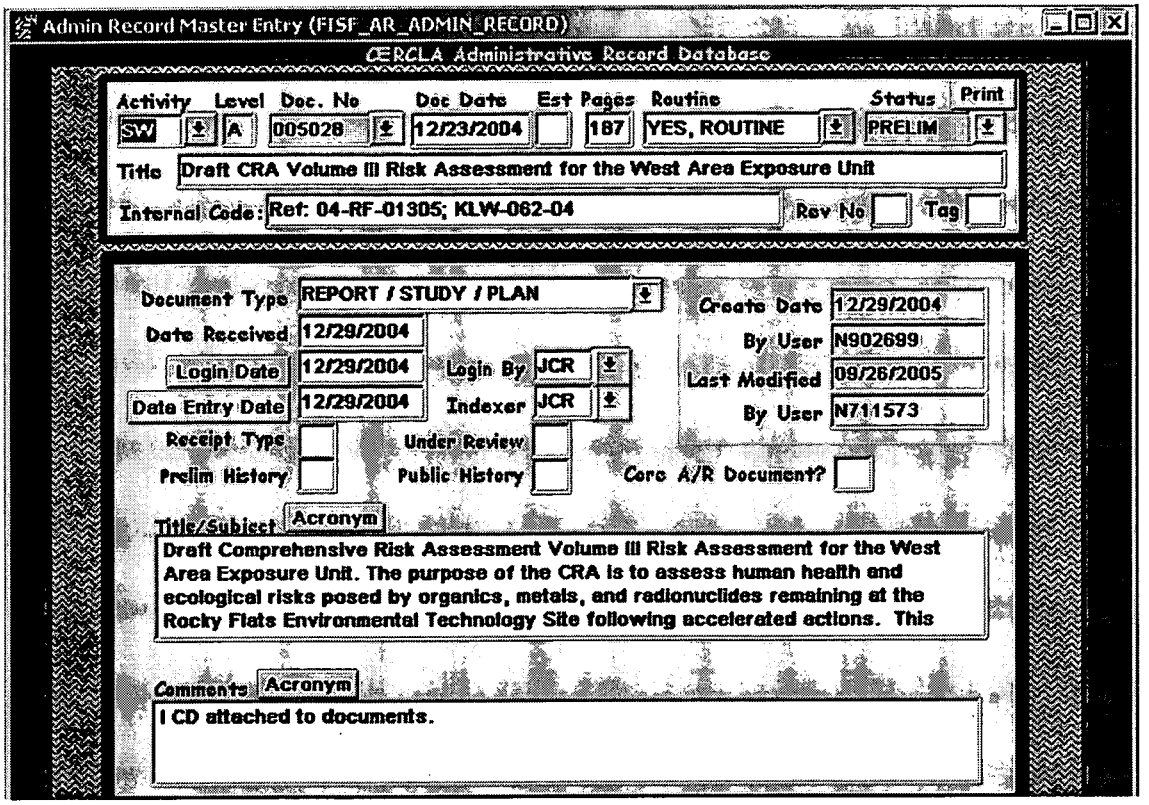
Table B42
Maximum Detection and Reporting Limits for Water Quality Parameters

Method Name	Sample Type	Analyte	Result	Units	Laboratory Qualifier	Detection Limit	PRG	Units
WQPL	BH	Cyanide	0.01	mg/L	U	0.01	40.56	mg/L
WQPL	GW	Cyanide	0.01	mg/L	U	10	40.56	mg/L
WQPL	SW	Cyanide	0.01	mg/L	U	10	40.56	mg/L
WQPL	SW	Nitrite	0.1	mg/L	U	0.1	202.78	mg/L

DRAFT COMPREHENSIVE RISK ASSESSMENT

VOLUME 3: APPENDIX C
Statistical Analysis

(To be added later)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CERCLA Administrative Record Database
Activity
Level
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Doc Date
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Routine
Status
Print
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005028
12/23/2004
187
YES, ROUTINE
PRELIM
Title
Draft CRA Volume III Risk Assessment for the West Area Exposure Unit
Internal Code:
Ref: 04-RF-01305; KLW-062-04
Rev No
Tag
Document Type
REPORT / STUDY / PLAN
Create Date
12/29/2004
Date Received
12/29/2004
By User
N902699
Login Date
12/29/2004
Login By
JCR
Last Modified
09/26/2005
Date Entry Date
12/29/2004
Indexer
JCR
By User
N711573
Receipt Type
Under Review
Prelim History
Public History
Core A/R Document?
Title/Subject
Acronym
Draft Comprehensive Risk Assessment Volume III Risk Assessment for the West Area Exposure Unit. The purpose of the CRA is to assess human health and ecological risks posed by organics, metals, and radionuclides remaining at the Rocky Flats Environmental Technology Site following accelerated actions. This
Comments
Acronym
1 CD attached to documents.